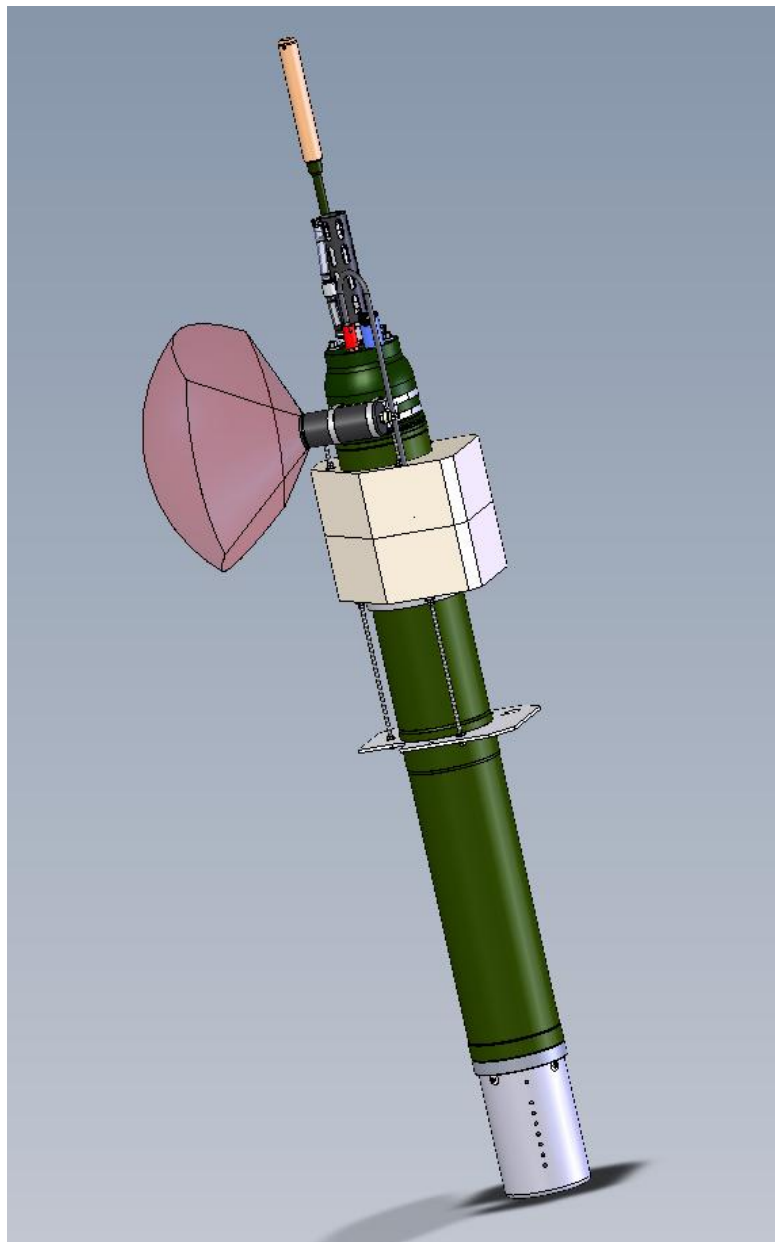


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## USER MANUAL

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DOC du 24 / 09 / 13 rev.3

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DATE	REVISION	OBJET	Auteur
20/07/12	0	Création (prototype)	JS
15/01/12	1		JS
06/03/13	2		JS
04/09/13	3		JS

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## 1 INTRODUCTION

ProvBioll is a subsurface profiling float developed jointly by IFREMER and NKE.

The ProvBioll float described in this manual is designed for the ARGO Program. This international program will be a major component of the Global Ocean Observing System (GOOS). An array of 3,000 free-drifting profiling floats is planned for deployment in 2004. These floats will measure the temperature and salinity of the upper 2,000 meters of the ocean, allowing continuous monitoring of the ocean's climate.

All Argo measurements will be relayed and made publicly available within hours after collection. The data will provide a quantitative description of the evolving state of the upper ocean and the patterns of ocean climate variability, including heat and freshwater storage and transport. It is expected that ARGO data will be used for initialization of ocean and coupled forecast models, and for dynamic model testing. A primary focus of Argo is seasonal to decadal climate variability and predictability.

After launch, ProvBioll's mission consists of a repeating cycle of descent, submerged drift, ascent and data transmission. During these cycles, ProvBioll dynamically controls its buoyancy with a hydraulic system. This hydraulic system adjusts the density of the float causing it to descend, ascend or hover at a constant depth in the ocean. The user selects the depth at which the system drifts between descent and ascent profiles. ProvBioll continually samples the pressure at this drift depth and maintains that depth within approximately +/-50m.

After the submerged drift portion of a cycle, the float proceeds to the depth at which the ascending profile is to begin. The ascent profile starting depth (typically the ARGO-selected depth of 2,000m) is not necessarily the same as the drift depth.

During its mission, ProvBioll collects measurements of several parameters (depending on sensor mounted) - salinity, temperature, depth, dissolved oxygen, Chlorophyll A, CDOM, Backscattering, Nutrients, ... - and saves them in its memory. These measurements can be sampled during the float descent (descent profile), during the submerged drift period (Lagrangian operation) and during the ascent (ascent profile).

After each ascent, ProvBioll transmits its saved data to the satellites of the Iridium system.

This manual describes the ProvBioll float, how to use it and safety precautions to be observed during handling.

Please read this manual carefully to ensure that ProvBioll functions as intended.

Overview of the present manual's contents:

- Chapter 2 contains the instructions necessary for the personnel in charge of the deployment
- Chapter 3 describes the components of ProvBioll ; it is intended for those who want a more in-depth understanding of ProvBioll
- Chapter 4 describes the mission of ProvBioll
- Chapter 5 describes the various parameters
- Chapter 6 describes the user commands that can be send to the float
- Chapter 7 describes the formats of the various Iridium messages
- Chapter 8 presents the technical specifications
- Chapter 9 provides explanations about the operation of ProvBioll
- Chapter 10 specifies the elements of the constraints limited to the transport of Lithium batteries.

## 2 OPERATING INSTRUCTIONS

The following instructions tell you how to handle, configure, test and launch the ProvBioII float. Please read these instructions carefully and follow them closely to ensure your ProvBioII float functions as intended.

### 2.1 Handling Precautions

ProvBioII is designed to withstand submersion at great depths for long periods of time (up to five years). This remarkable specification in oceanographic instrumentation is possible thanks to the protection of the casing by an anti-corrosion coating. This coating is sensitive to impact. Damage to the coating can accelerate the corrosion process.

**NOTE:** *Take precautions to preserve the anti-corrosion coating during handling. Remove the float from its packing only when absolutely necessary.*

**NOTE:** *Regulations state that ProvBioII must not be switched on during transport.*

### 2.2 Acceptance Tests

Immediately upon receipt of the ProvBioII float, you should test it to confirm that it is complete, correctly configured and has not been damaged in shipment. If your ProvBioII float fails any of the following tests, you should contact **nke electronics**.

#### 2.2.1 Inventory

The following items should be supplied with your ProvBioII float:

- The present user manual.
- A test sheet.

**NOTE:** *Disassembly of the float voids the warranty.*

Check that all of the above items are present. If any are missing, contact **nke**.

#### 2.2.2 Physical Inspection

Upon the opening of the transport casing, visually inspect the float's general condition: Inspect the transport container for dents, damage, signs of impact or other signs that the float has been mishandled during shipping.

Inspect the CTD sensor, antenna, hull, housing around the lower bladder for dents or any other signs of damage

**NOTE:** *Ensure the magnet is in place against the hull (on ON/OFF position).*

### 2.3 Default Parameters

Notwithstanding special instructions given to NKE during the ProvBioII preparation stage, the following set of parameters is applied: section 5.

If these parameters are not appropriate, the user can change them himself by following the instructions.

#### 2.3.1 ARGO Identification

The user is responsible for contacting the AIC in order to obtain the WMO number which will identify the ProvBioII's mission.

#### 2.3.2 Decoding

The CORIOLIS project team (IFREMER) is able to assist the teams that use ProvBioII for data processing.

## 2.4 Launching

Following is what you should do to launch the ProvBioII float.

### 2.4.1 Test the Float and arm the mission

Before you take ProvBioII on deck for deployment, we recommend that you repeat all of the tests described in [section 2.5.8](#). This will ensure that the float is functioning and configured correctly and maximize the probability of success of your experiment.

**IMPORTANT:** Before launching the float, you must arm the mission by issuing the !AR 1 command:

!AR ON

ProvBioII will respond :

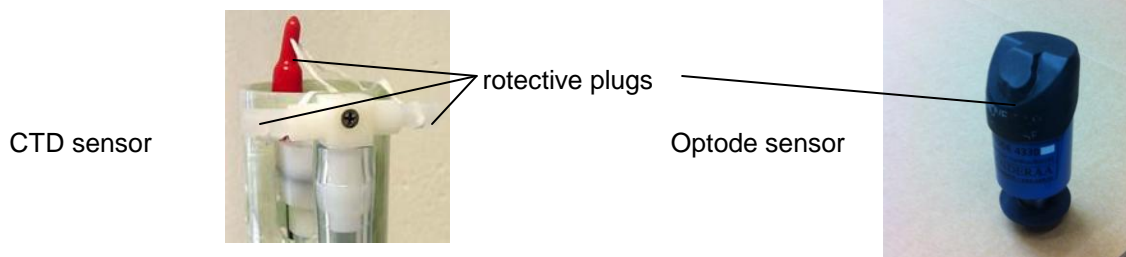
<AR ON>

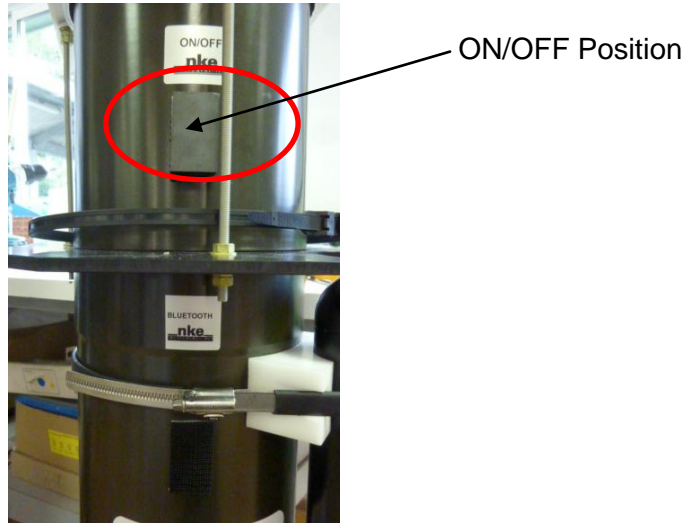
Put the magnet on the float (ON/OFF position).

**NOTE:** *Once the mission is armed, the next time you will attempt to communicate with the float upon magnet removal, you need to establish Bluetooth connection (see [section 2.5.2](#)) and press "ENTER" within 30 seconds in order to get the prompt ].*

### 2.4.2 Remove protective plugs and magnet

The pump system of the CTD sensor is sealed by 3 protective plugs. Remove these plugs from the sensor before launching.





Remove the magnet located near the top of the float (see Figure 1 – General view of ProvBioII float ). Retain the magnet for future use in case the float is recovered.

ProvBioII is now ready for launch.

To confirm that the magnet has been removed and that the float is ready for launch, 5 seconds after magnet removal, ProvBioII starts 5 valves actions. After 80s, the seabird pump is active. If you have water in the CTD, this water go out by the holes where was the protectives plugs. After 100 sec, floats starts 5 quick valve activations.

**NOTE:** *Once the magnet has been removed, the ProvBioII float performs an initial test (if Armed Mode is ON only). Ensure that the CTD pump starts as explained above before placing the float in the water.*

If your do not hear the valve running after 30 seconds, and you do not see the water after 90s, replace the magnet, connect the PC, and conduct the tests described in **section 2.5**. If these tests fail, contact **nke** technical support.



### 2.4.1 Deployment checklist

Test	Description	Expected Result	Result
<b>Check before deployment</b>			
1	Visual inspection	No scratch, good general state	<input type="checkbox"/> <b>OK</b>
2	Magnet Position	Magnet placed on ON/OFF position (means OFF)	<input type="checkbox"/> <b>OK</b>
3	Remove all sensor plugs	Plugs removed (see <a href="#">section 2.4.2</a> )	<input type="checkbox"/> <b>OK</b>
4	Distilled Water in conductivity cell	Introduce distilled water in conductivity cell (enable CTD pump check on test 5 & 8)	<input type="checkbox"/> <b>OK</b>
<b>Check during deployment (Float must be <u>on VERTICAL position</u>)</b>			
5	Magnet removal	Magnet removed from ON/OFF position	<input type="checkbox"/> <b>OK</b>
6	5 slow Ev activations	5 slow Ev activations heard (5-15 sec after magnet removal)	<input type="checkbox"/> <b>OK</b>
7	Hydraulic pump	Hydraulic pump activation to fill in external bladder (from 5 sec to several minutes depending on bladder state at deployment)	<input type="checkbox"/> <b>OK</b>
8	CTD pump	Water level change in CTD water circuit	<input type="checkbox"/> <b>OK</b>
8b	Optical sensor (option)	Optical sensor activation (Light on ECO-FL sensor)	<input type="checkbox"/> <b>OK</b>
9	5 quick Ev activation	5 quick Ev activations heard	<input type="checkbox"/> <b>OK</b>
10	Delay before mission	Wait for “ <u>PM1</u> ” Minutes	<input type="checkbox"/> <b>OK</b>
11	CTD pump	Water level change in CTD water circuit	<input type="checkbox"/> <b>OK</b>
12	Hydraulic pump	Hear Hydraulic pump (2 sec)	<input type="checkbox"/> <b>OK</b>
13	Iridium Transmission	Iridium transmission (files received by mail)	<input type="checkbox"/> <b>OK</b>
<b>Deployment</b>			
14	Deployment	Deployment system in place	<input type="checkbox"/> <b>OK</b>
15	Float drift	Float drift at surface	<input type="checkbox"/> <b>OK</b>

If **step 9** is not reached and Iridium message are not received, place magnet on ON/OFF position and try again from beginning. To check iridium transmission & GPS acq, it is recommended to reach **step 13**

**Do not DEPLOY after 3 unsuccessful tries !**

### **2.4.2 Launch the Float**

**NOTE:** *Keep the float in its protective packaging for as long as possible to guard against any nicks and scratches that could occur during handling. Handle the float carefully, using soft, non-abrasive materials only. Do not lay the float on the deployment vessel's unprotected deck. Use cardboard or cloth to protect it.*

#### **2.4.2.1 By hand**

ProvBioII can be launched by hand from the deck from a height of 2 meters

#### **2.4.2.2 Using a rope**

The damping disk is already fastened on the tube (under the buoyancy foam).

It is possible to use the holes in the damping disk in order to handle and secure the float during deployment.

**After the launch, you may decide to wait alongside the float until it starts its descent, but this can take up to 3 hours depending on the float's buoyancy when it is placed in the water.**

## 2.5 Checks prior to deployment

### 2.5.1 Necessary Equipment

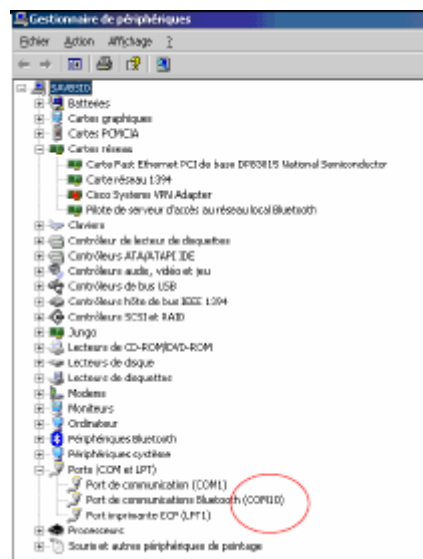
The equipment required to check that ProvBioII is functioning correctly and to prepare it for the mission are:

- (1) A PC.  
The most convenient way of communicating with ProvBioII is with a PC in terminal emulation mode. Among other advantages, this allows storage of configuration parameters and commands. You can use any standard desktop or laptop computer. The PC must be equipped with a serial port (usually called COM1 or COM2).
- (2) VT52 or VT100 terminal emulation software.  
The Hyper Terminal emulation software can be used.
- (3) A Bluetooth Dongle with drivers installed on the PC (BELKIN class 2 model is recommended).
- (4) An accurate time source.  
This could be a wristwatch, a GPS receiver or the PC's internal clock. Some users use a GPS receiver connected to the PC to adjust the clock.

### 2.5.2 Connecting the PC

Make sure you check the following points before attempting a connection:

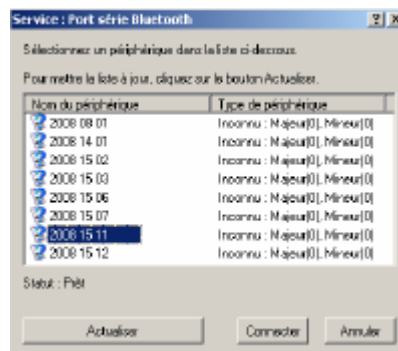
- ✓ Bluetooth key connected to the PC with the drivers installed
- ✓ Magnet present at the Bluetooth's power supply ILS (see Figure 1 – General view of ProvBioII float
- ✓ Start Hyperterminal after checking on which COM port the Bluetooth key is installed by going to: Control Panel->System-> click on Hardware tab->Device Manager as shown in the figure below:



- ✓ On the PC, run the following commands as shown in the figure below:
- ✓ Right click on the Bluetooth logo in the bottom right corner of the Desktop
- ✓ Select Quick Connect, Bluetooth Serial Port, then click on other devices



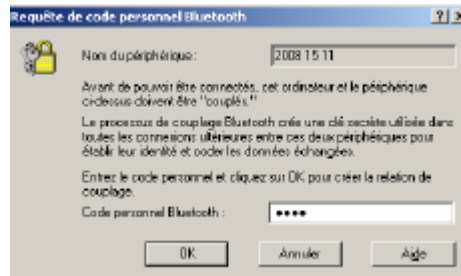
A window appears as shown in the figure below:



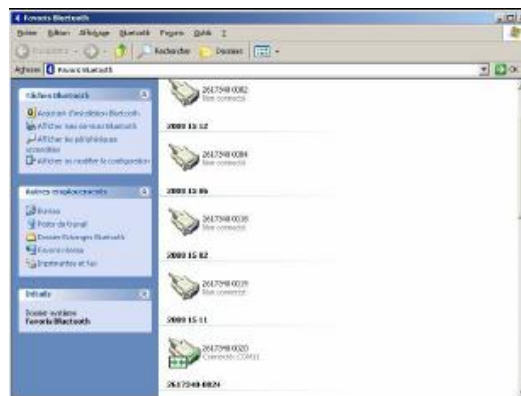
- ✓ Click on Refresh
- ✓ Check that the Bluetooth number is present on the traceability label (see Figure 1 – General view of ProvBioII float)
- ✓ There are two ways of establishing the connection:
- ✓ Either select the number shown and press Connect
- ✓ Or come back to the previous step and instead of selecting “other devices”, select the number shown
- ✓ When the connection is made, a dialog box appears as shown in the figure above:



Double click on it and a window appears as shown below:



- ✓ Enter the security code “0000”
- ✓ You can now check the connection by double clicking on the Bluetooth logo in bottom right corner of the Desktop
- ✓ The “Bluetooth favourites” window appears:



Use your PC's terminal emulation software to configure the selected serial port for:

- 9,600 baud
- 8 data bits
- 1 stop bit
- Parity: none
- Full duplex
- No flow control

### 2.5.3 Example of Bluetooth dongle tested by NKE



USB Bluetooth™ adaptor - 100 meters,  
Part # F8T012fr  
Made by Belkin

### **2.5.4 How to Send Commands**

You must communicate with ProvBioII to verify or change its configuration parameters, to read data from the float, or to test the float's functions. You perform these verifications/changes by sending commands, and by observing the float's response to those commands. Compose commands by typing characters on the keyboard of your PC, and send them to ProvBioII by pressing the Enter key.

In the following descriptions of commands we will use the general syntax:

- Keystrokes entered by the user are written in **bold**.
- Replies received from the float are in normal font.
- Commands entered by the user end with the Enter key.

The software version can be viewed using the **?VL** command

ProvBioII will respond:

```
<ProvBioII >
<VL V1_06 >
<TX IRIDIUM>
Get measure ?VL
SOFTWARE VERSION Measure: V0.24.100
]
```

The float's serial number can be viewed using the **?NS** command

ProvBioII will respond:

```
<NS 1202>
Get measure ?NS
SERIAL NUMBER Measure: 1202
] (year 12, identification 2)
```

### **2.5.5 How to Read and change Parameter Values**

Read the values of "mission parameters" by sending the PM command. Do this by typing the characters **?PM** or **?PV** or **?PI** or **?PT** or **?PC** (respectively for mission parameters, Vector parameters, Rudics parameters, Technical parameters and Sensor parameters) in response to ProvBioII 's prompt character ("]") then confirm the command by pressing the Enter key. It should look like this:

**?PM**

ProvBioII will respond:

```
<PM0 1>
<PM1 0>
<PM2 1>
<PM3 1>
<PM4 4>
<PM5 1000>
<PM6 2000>
<PM7 0>
...
<PM51 2000>
<PM52 1>
]
```

As you can see, the responses are of the form:

- PM parameter number, value.

You can also read the values of the parameters individually using the command

**? PM X**

where **X** identifies the parameter. Each parameter is identified by a parameter number corresponding to a parameter name. They are summarised for reference in section 5.1

	Abbr.	NAME	DEFAULT VALUE	UNIT	MIN VALUE	MAX VALUE
	PM0	Number of profiles per cycle	1	-	1	10
	PM1	Delay Before Mission	0	Minutes	0	1440
	PM2	Reference Day	1	Mission day	0	364
1 <sup>st</sup> P R O F I L E	PM3	Day for 1 <sup>st</sup> surfacing	1	Mission day	1	364
	PM4	Estimated hour for 1 <sup>st</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM5	Drift Depth	1000	dBars	100	2000
	PM6	Profile Depth	2000	dBars	100	2030
	PM7	Transmission for 1st profile (0 = N, 1 = Y)	0		0	1
2 <sup>nd</sup> P R O F I L E	PM8	Day for 2 <sup>nd</sup> surfacing	1	Mission day	1	364
	PM9	Estimated hour for 2 <sup>nd</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM10	Drift Depth	1000	dBars	100	2000
	PM11	Profile Depth	2000	dBars	100	2030
	PM12	Transmission for 2 <sup>nd</sup> profile (0 = N, 1 = Y)	0		0	1
3 <sup>rd</sup> P R O F I L E	PM13	Day for 3 <sup>rd</sup> surfacing	1	Mission day	1	364
	PM14	Estimated hour for 3 <sup>rd</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM15	Drift Depth	1000	dBars	100	2000
	PM16	Profile Depth	2000	dBars	100	2030
	PM17	Transmission for 3 <sup>rd</sup> profile (0 = N, 1 = Y)	0		0	1
4 <sup>th</sup> P R O F I L E	PM18	Day for 4 <sup>th</sup> surfacing	1	Mission day	1	364
	PM19	Estimated hour for 4 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM20	Drift Depth	1000	dBars	100	2000
	PM21	Profile Depth	2000	dBars	100	2030
	PM22	Transmission for 4 <sup>th</sup> profile (0 = N, 1 = Y)	0		0	1
5 <sup>th</sup> P R O F I L E	PM23	Day for 5 <sup>th</sup> surfacing	1	Mission day	1	364
	PM24	Estimated hour for 5 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM55	Drift Depth	1000	dBars	100	2000
	PM26	Profile Depth	2000	dBars	100	2030
	PM27	Transmission for 5 <sup>th</sup> profile (0 = N, 1 = Y)	0		0	1
6 <sup>th</sup> P R O F	PM28	Day for 6 <sup>th</sup> surfacing	1	Mission day	1	364
	PM29	Estimated hour for 6 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM30	Drift Depth	1000	dBars	100	2000
	PM31	Profile Depth	2000	dBars	100	2030

I L E	PM32	Transmission for 6 <sup>th</sup> profile (0 = N, 1 = Y)	0		0	1
7 <sup>th</sup>  P R O F I L E	PM33	Day for 7 <sup>th</sup> surfacing	1	Mission day	1	364
	PM34	Estimated hour for 7 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM35	Drift Depth	1000	dBars	100	2000
	PM36	Profile Depth	2000	dBars	100	2030
	PM37	Transmission for 7 <sup>th</sup> profile (0 = N, 1 = Y)	0		0	1
8 <sup>th</sup>  P R O F I L E	PM38	Day for 8 <sup>th</sup> surfacing	1	Mission day	1	364
	PM39	Estimated hour for 8 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM40	Drift Depth	1000	dBars	100	2000
	PM41	Profile Depth	2000	dBars	100	2030
	PM42	Transmission for 8 <sup>th</sup> profile (0 = N, 1 = Y)	0		0	1
9 <sup>th</sup>  P R O F I L E	PM43	Day for 9 <sup>th</sup> surfacing	1	Mission day	1	364
	PM44	Estimated hour for 9 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM45	Drift Depth	1000	dBars	100	2000
	PM46	Profile Depth	2000	dBars	100	2030
	PM47	Transmission for 9 <sup>th</sup> profile (0 = N, 1 = Y)	0		0	1
10 <sup>th</sup>  P R O F I L E	PM48	Day for 10 <sup>th</sup> surfacing	1	Mission day	1	364
	PM49	Estimated hour for 10 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM50	Drift Depth	1000	dBars	100	2000
	PM51	Profile Depth	2000	dBars	100	2030
	PM52	Transmission for 10 <sup>th</sup> profile (0 = N, 1 = Y)	1		0	1

For example, to verify the value of the drift pressure target (1<sup>st</sup> profile), send the command:

### ? PM 5

ProvBioII will respond:

<PM5 1000>

]

The commands for **changing** the values of the mission parameters are of the form:

### !PM X Y

where X identifies the parameter and Y provides its new value.

For example, to change the profile depth to 2030 (max value) for 1<sup>st</sup> profile, send the command:

!PM 06 2030

ProvBioII will respond:

<PM6 2030>

**NOTE:** *ProvBioII will always respond by confirming the present value of the parameter. This is true even if your attempt to change the parameter's value has been unsuccessful, so you should observe carefully how ProvBioII responds to your commands.*



In a same way, to read vector parameters, user send the command :

**?PV**

Float will respond with vector parameters list.

To read sensor parameters, send the command :

**?PC x** with x is sensor number identification (see section 5.3 for more details).

Float will respond with Sensor “x” parameters list.

All command list is given in section 6 “USER COMMANDS”

## **2.5.6 How to Check and change the Time**

Connect the PC to the float using the BT connection (see section 2.5.2). Ask ProvBioII to display the time stored in its internal clock by sending the command:

**? TI**

(Do this by typing the characters **? TI** followed by the Enter key). ProvBioII will respond:

Get measure ?TI

Command Measure: ?TI

#TI 15:29:11 12/09/12

DATE/TIME Measure: 15:29:11 12/09/12

]]

The date and time are in the format hh:mm:ss DD/MM/YY

You can set the time on the float's internal clock by sending the command:

**!TI DD MM YY hh mm ss**

For example, if you send the command:

**!TI 01 03 13 14 30 00**

ProvBioII will respond:

01/03/13, 14h 30m 00s

## **2.5.7 Configuration Check**

The float has been programmed at the factory. The objective of this portion of the acceptance test is to verify the float's configuration parameters.

Connect the PC to the float (see section 2.5.2). Send the PM command, as explained in section 2.5.5. to verify that ProvBioII 's parameters have been set correctly.

## **2.5.8 Functional Tests**

Connect the PC to the float (see section 2.5.2).

**NOTE: The hydraulic components will function correctly only if the float is in a vertical position with the antenna up.**

Orient the float vertically, and support it to prevent it from falling over during the performance of the functional tests.

ProvBioII has several commands that allow you to test its various functions.

### 2.5.8.1 Complete AUTO-TEST

Send the command :

**!C**

ProvBioII will respond:

\*\*\*AUTOTEST\*\*\*

\*\*\*Test FLASH\*\*\*

< FLASH: OK (DB7C) >

\*\*\*Test VACUUM\*\*\*

< VACUUM: OK (700) >

\*\*\*Test BAT\*\*\*

< BAT: OK >

\*\*\*Test RES\*\*\*

Remplissage reservoir

<RV ON>

< RES: OK >

\*\*\*Test MEASURE\*\*\*

< MEASURE: OK >

\*\*\*Test MODEM\*\*\*

< MODEM: OK >

\*\*\*\*AUTOTEST OK\*\*\*\*

]

Sensor will be tested only if sampling period is different from zero (at least in one phase and/or zone).

Sampling period description can be find in section 5.3.2.

### 2.5.8.2 Display of technological parameters

2 commands are used (?VB and !RV):

Send the command:

**?VB**

ProvBioII will respond:

\*\*\*Mesure vide interne\*\*\*

<B:107 V:705 (A=1.687 B=-368.240)>

] -> means 705 mBar internal and 10.7V Battery pack voltage

- Internal vacuum (V).

This vacuum is drawn on the float as one of the final steps of assembly. It should be between 600 and 800 mbar absolute. 700 mbar is recommended (with external bladder full @ 20°C).

- Battery voltage (B)

Normal values for a new battery are 10.8 volts (see test sheets for limits).

Send the command :

**!RV**

Float will respond with:

<RV ON> if lower blade is full.

If lower blade is not full pump will activate until oil has been transferred and lower blade is full. By this way, initial buoyancy will be maximal at deployment.

Before using RV command, float must be in vertical position. If float is in box, test could be false.

## 2.5.8.3 Test of CTD sensor (sensor 0)

This command is used to display:

- External pressure (P).
- Temperature (T).
- Salinity (S).

Send the command:

**?ME 0**

ProvBioII will respond:

Get mesure ?ME

Command Measure: ?ME 0

JONE SHOT Measure: 0 CTD -0.0548 24.8029 0.4743

As this sensor is in open air, only the temperature data should be regarded as accurate.

## 2.5.8.4 Test of Oxygen sensor (sensor 1)

This command is used to perform an acquisition on the oxygen sensor.

Send the command :

**?ME 1**

Float will respond with :

< Get measure ?ME 1

ONE SHOT Measure: 1 DO 43 586 32.6750 2.6810 26.5220 >

## 2.5.8.5 Test of FLBB sensor (sensor 4)

This command is used to perform an acquisition on the FLNTU sensor.

Send the command :

**?ME 4**

Float will respond with :

< Get measure ?ME 4

ONE SHOT Measure: 4 FLBB 99/99/99 99:99:99 695 53 700 158 530 >

## 2.5.8.6 Test Hydraulic Pump

To activate the pump for one second, send the command:

**!P 100**

Listen for the pump running for one second (unit: centiseconds).

## 2.5.8.7 Test Hydraulic Valve

To activate the valve for one second, send the command:

**!E 100**

Listen for the actuation of the valve (unit: centiseconds).

## 2.5.8.8 Test GPS/Iridium Subsystem

Float must be placed in free area, in order satellite communication (GPS and Iridium) can be performed

To test the Iridium transmitter, send the command :

**!SE**

The float will reprogram time with GPS, then will send a technical message. Put the magnet back in place to stop the transmission.

This command will cause ProvBioII to transmit several messages. They are technical messages, the format of which is described in section 7.

Use email address you give to provider at Iridium activation request, to check transmission was OK (SBD transmission mode only) or check transmitted file on rudics server (rudics transmission mode). The message content is not meaningful, this is a test of the transmission only.

You have now completed the functional tests. Ensure the magnet is in place on the ON/OFF position (see **Figure 2**).

### **3 GENERAL DESCRIPTION OF PROVBIOII FLOAT**

#### **3.1 ProvBioII**

The main developments of ProvBioII compared to the CTS-3.1 float are mainly:

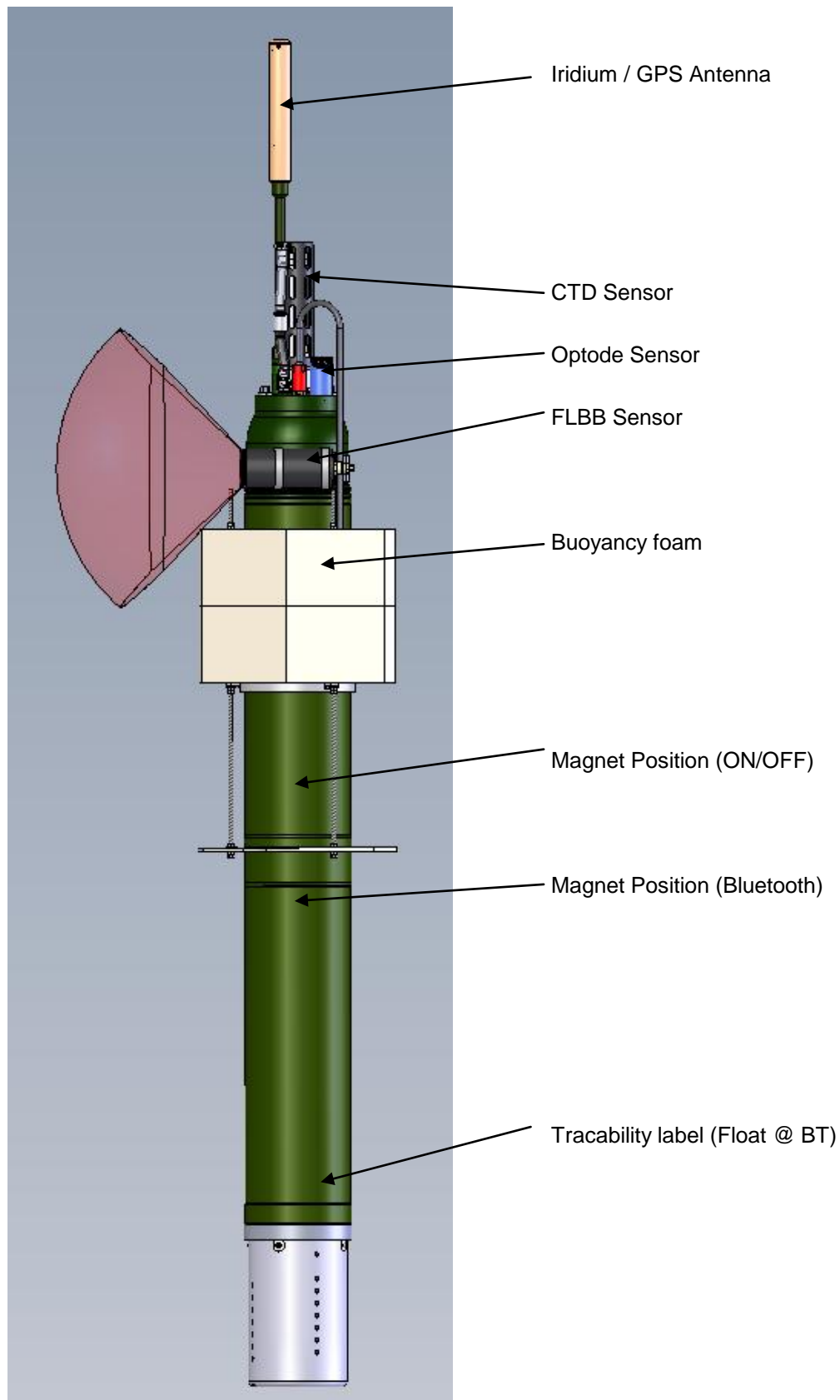
- ✓ Embedded software,
- ✓ Electronics,
- ✓ Mechanical interface with sensors

##### **3.1.1 Electronics**

A new CPU board has been developed to take in account the obsolescence of components of the CTS-3.1 PROVOR profiler. A new electronic board has been designed to deal with sensor acquisition and treatment.

##### **3.1.2 Embedded software**

The CPU board is equipped with a new embedded software taking in account supplementary inputs and possibilities required by the new electronic design including two boards : one for float managing and the other for sensor..



**Figure 1 – General view of ProvBioII float**

### **3.2 Density Control System**

Descent and ascent depend upon buoyancy. ProvBioII is balanced when its density is equal to that of the level of surrounding water. The float has a fixed mass. A precision hydraulic system is used to adjust its volume. This system inflates or deflates an external bladder by exchanging oil with an internal reservoir. This exchange is performed by a hydraulic system comprising a high-pressure pump and a solenoid valve.

The interested reader is referred to a more detailed description of the operation of ProvBioII 's density control system in **section 9**.

### **3.3 Sensors**

ProvBioII is equipped with precision instruments for measuring :

- pressure, temperature and salinity with the SEABIRD SBE41CP CTD sensor. Specifications of the sensor are provided in **section 8**.
- Dissolved Oxygen with the Oxygen Optode AANDERAA 3830 or 4330 sensor
- FLBB Sensor (WETLABS sensor)

### **3.4 Iridium Transmitter**

While the float is at the surface, the Iridium transmitter sends stored data to the satellites of the Iridium system (see **sections 7. And 7.1.**). The transmitter has a unique ID assigned by Iridium (IMEI number). This ID identifies the individual float. The Iridium antenna is mounted on the top end of the ProvBioII float and must be above the sea surface in order for transmissions to reach the satellites.

### **3.5 CPU Board**

This board contains a micro-controller (or CPU) that controls ProvBioII . Its functions include maintenance of the calendar and internal clock, supervision of the depth cycling process and activation and control of the hydraulics.

This board allows communication with the outside world for the purpose of testing and programming.

### **3.6 Measure Board**

This board contains a micro-controller (or CPU) that drive all sensors (power ON & OFF, frame acquisition, storage, treatment and communication with CPU board for transmission phase.

### **3.7 Battery**

A battery of lithium thionyl chloride cells supplies the energy required to operate ProvBioII .

### **3.8 MMI link**

The User link is made via Bluetooth (radiofrequency link)

## 4 THE LIFE OF AN PROVBIOII FLOAT

The life of an ProvBioII float is divided into four phases: Storage/Transport, Deployment, Mission, and Life Expiry.

### (1) **Storage/Transport**

During this phase, the float, packed in its transport case, awaits deployment. The electronic components are dormant, and float's buoyancy control functions are completely shut down. This is the appropriate status for both transport and storage.

### (2) **Deployment**

The float is removed from its protective packaging, configured, tested and launched at sea.

### (3) **Mission**

The mission begins with the launching of the float. During the Mission, ProvBioII conducts a pre-programmed number of cycles of descent, submerged drift, ascent and data transmission. During these cycles it collects measurement data and transmits it to the Iridium satellite system.

### (4) **Life Expiry**

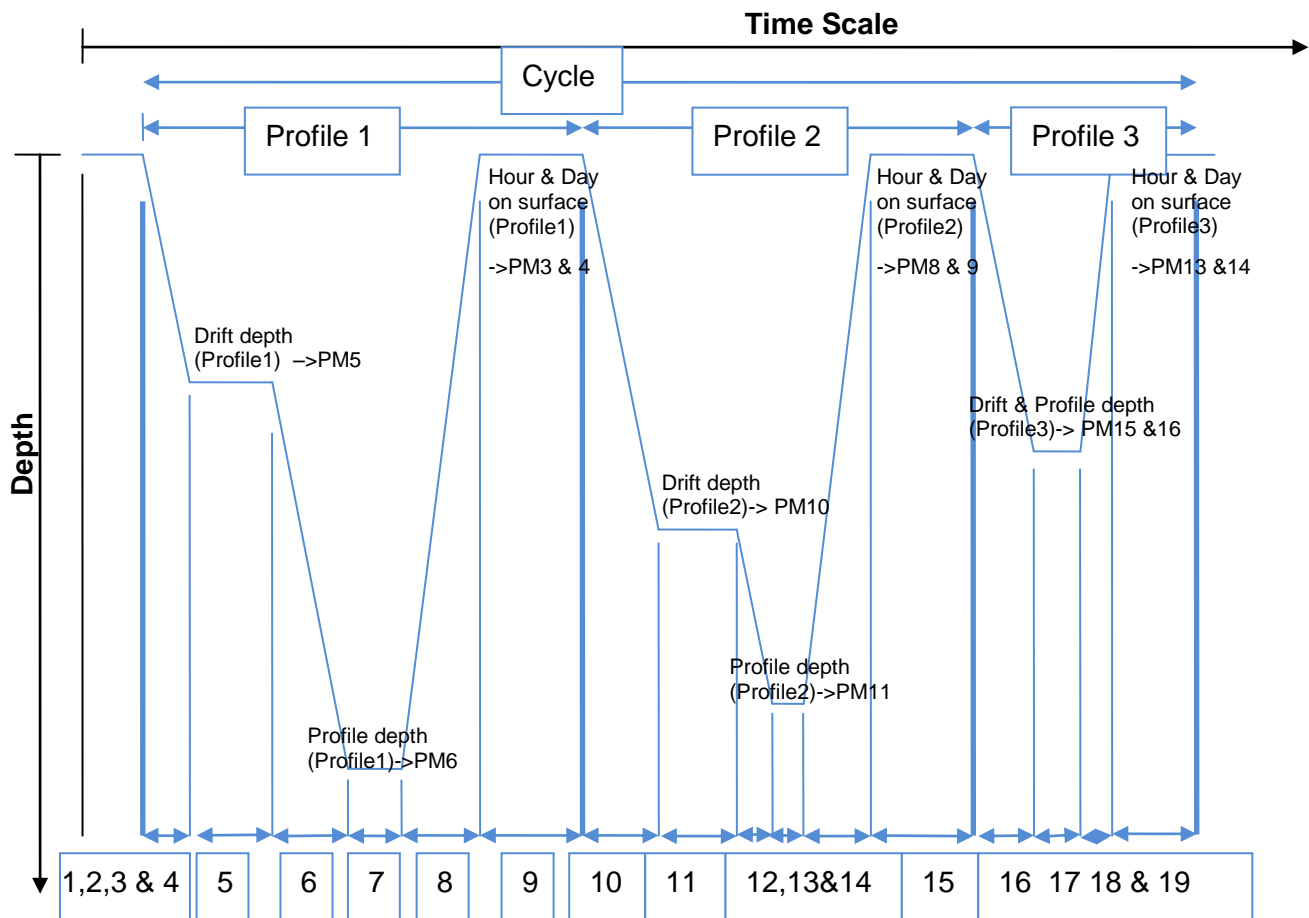
Life Expiry begins automatically upon completion of the pre-programmed number of cycles. During Life Expiry, the float, drifting on the sea surface, periodically transmits messages until the battery is depleted. Reception of these messages makes it possible to locate the float, to follow its movements and, if desired, to recover it. ProvBioII floats are designed to be expendable, so recovery is not part of its normal life cycle. However, float can be ordered to enter in new mission with specific telecommand.

If the battery is depleted before completion of the pre-programmed number of cycles, ProvBioII will probably remain submerged and cannot be located or recovered.

### 4.1 The Mission - Overview

We call "Mission" the period between the moment when the float is launched at the experiment zone and the moment when the data transmission relating to the final depth cycle is completed.

During the Mission, ProvBioII conducts ascent and descent profiles, separated by periods of Iridium transmitting and drifting at a predetermined depth. ProvBioII can collect data during the descent, submerged drift, or ascent portions of the cycle, and transmits the collected data during the surface drift period at the end of each cycle. One cycle is shown in the figure below.



**Figure 2 - Schematic representation of a PROVIO-II's cycle (ex with 3 profiles) during the Mission**

**(1) Delay Before Mission**

To prevent ProvBioII from trying to sink before it is in the water, the float waits for this time before starting its descent. This happens only before the first cycle; it is not repeated at each cycle.

**(2) IRIDIUM Preliminary Transmissions**

To test Iridium transmitter, before descent phase, float will perform Iridium transmission by sending a technical message. A GPS position will be acquired and transmitted in technical message.

**(3) Buoyancy reduction (1<sup>st</sup> profile)**

Float is deployed with full external bladder to get a maximal buoyancy. To reach a neutral buoyancy position before descending, float needs to transfer oil inside float. For the 2 first cycles this phase can take up to one hour and a half (by opening electro-valve several times with one minute for pressure monitoring between activations). At following cycles, float memorizes necessary global electro-valve opening time (precedent cycle) and reduce this global duration by reducing time between valve activations to 4 seconds instead of 1 minute.

**(4) Descent (1<sup>st</sup> profile)**

The float descends with an average vertical speed of 3 cm/sec. During descent, which typically lasts a few hours, ProvBioII can detect possible grounding on a high portion of the seabed and can move away from such places (see [section 4.3](#). for more details on grounding).

**(5) Drifting at Depth (1<sup>st</sup> profile)**

During the drift period, ProvBioII drifts underwater at a user-selected drift depth, typically 1,000m to 2,000m below the sea surface. The drift period duration is user-selectable and can last from a few days to several weeks, but is typically 10 days. The float automatically adjusts its buoyancy if it drifts from the selected depth by more than 5 bars over a 60-minute period. ProvBioII can collect measurements at user-selected intervals during this drift period if the user selects this option.



### (6) Descent to Profile Depth (1<sup>st</sup> profile)

The user may select a starting depth for the ascent profile that is deeper than the drift depth. If this is the case, ProvBioII must first descend to the profile depth before beginning the ascent profile.

ProvBioII can detect a possible grounding during this descent and take corrective action (as described in [section 4.3.](#)).

### (7) Wait for Ascent Time (1<sup>st</sup> profile)

The user can program several floats to conduct profiles simultaneously. This makes it possible to use several ProvBioII floats in a network of synoptic measurements, even though the instruments have not been all deployed at the same time. If this is the case, it may be necessary for ProvBioII to standby at the profile starting depth while awaiting the scheduled ascent time.

### (8) Ascent (1<sup>st</sup> profile)

Ascent lasts a few hours, during which time ProvBioII ascends to the sea surface at an average speed of 9-10cm/sec.

### (9) Transmission (1<sup>st</sup> profile)

At the end of each cycle, the float finds sufficient buoyancy to ensure Iridium transmission quality. ProvBioII remains at the sea surface transmitting the data collected during the preceding drift- ascent portion of the cycle. Except for last profile of cycle, transmission can be requested or not. If transmission is not requested for 1<sup>st</sup> profiles of cycle, user must program a transmission for last profile, in order to transmit all data acquired during all profiles. According to [PM7](#) on 1<sup>st</sup> profile.

### (10) Buoyancy reduction + Descent (2<sup>nd</sup> profile)

### (11) Drifting at Depth (2<sup>nd</sup> profile)

### (12) Descent to Profile Depth (2<sup>nd</sup> profile)

### (13) Wait for Ascent Time (2<sup>nd</sup> profile)

### (14) Ascent (2<sup>nd</sup> profile)

### (15) Transmission (2<sup>nd</sup> profile). According to [PM12](#) on 2<sup>nd</sup> profile.

### (16) Buoyancy reduction + Descent (3<sup>rd</sup> profile)

### (17) Drifting at parking + drifting at Depth (3<sup>rd</sup> profile)

This profile is programmed with same Parking and Profile Depth

### (18) Ascent (3<sup>rd</sup> profile)

### (19) Transmission (3<sup>rd</sup> profile)

According to [PM17](#) on 3<sup>rd</sup> profile. Last transmission for cycle. If previous profiles were programmed without transmission, all data will be transmitted at this time. Transmission for last profile MUST be set to "1" by user

## 4.2 Descent

While the float is still at the sea surface ProvBioII measures and records its pressure sensor offset. This offset is used to correct all pressure measurements. The offset is transmitted in a technical message (see [section 7](#)) for a description of the technical message format). Descent takes the float from the sea surface to the drift depth. Initially, in order to avoid possible collisions with ships, ProvBioII's objective is to lose buoyancy in the shortest possible time. It does this by opening the solenoid valve for a time period that is initially long, but decreases as the float approaches its target depth.

## 4.3 Grounding

ProvBioII monitors itself for possible grounding on the seabed. During descent to drift depth, if the pressure remains unchanged for too long, ProvBioII enters a correction mode. The user selects one of two available modes during Mission programming before launch (technical parameter PT13) :

- Grounding Mode = 0 (PT13=0) : The pre-programmed drift depth is disregarded. The pressure at the time of grounding minus an offset (5 bar) is taken as the new value for the drift pressure. The float adjusts its buoyancy to reach this new drift depth. The drift depth reverts to its programmed value for subsequent cycles. If the grounded pressure is lower than a programmed threshold (20 bar), the float remains on the seabed until the next programmed ascent time.

- Grounding Mode = 1 (PT13=1) : the float remains where it is until the next scheduled ascent time. The pressure measured at grounding becomes the profile start pressure for the cycle in progress. The profile start pressure reverts to its programmed value for subsequent cycles.

### 4.4 Submerged Drift

While ProvBioII is drifting at drift depth, it checks the external pressure regularly to determine whether there is need either for depth adjustment or for an emergency ascent.

If the measured pressure differs from the drift depth pressure by more than a specified tolerance, and this difference is maintained, ProvBioII adjusts its buoyancy to return to the drift depth.

If the pressure increases by an amount that exceeds a factory-set danger threshold (technical parameter), ProvBioII immediately ascends to the sea surface.

If the user chooses, ProvBioII will collect measurements at user-selected intervals during submerged drift.

### 4.5 Ascent

If the chosen ascent profile starting pressure is higher than the drift pressure, the float must first descend to reach the profile starting pressure.

If grounding is detected while ProvBioII is descending to the profile starting pressure, the present pressure is substituted for the profile starting pressure. This substitution is only for the cycle in progress; the profile starting pressure reverts to its pre-programmed value for subsequent cycles.

Once the profile starting pressure has been reached, the float waits for the programmed time to begin the ascent. If this time is reached before the float has arrived at the profile starting pressure, the ascent starts immediately.

ProvBioII ascends by repeated use of the pump. When the pressure change between two successive measurements is less than 1 bar, the pump is activated for a pre-set time period. In this way, the pump performs minimum work at high pressure, which ensures minimum electrical energy consumption. The average speed of ascent is approximately 9-10cm/sec. For a 2,000m profile, the ascent would therefore last 6 hours.

When the pressure drops below 1 bar (signifying completion of ascent), ProvBioII waits 10 minutes and then activates the pump in order to empty the reservoir and achieve maximum buoyancy. Sensor measurements begin at the profile start time and stop 10 minutes after the float rises above the 1 bar isobar in its approach to the sea surface.

### 4.6 Multi-Profiles

ProvBioII float can realize up to 10 profiles per cycle. All profiles are independently parametered.

For each profile, user can set, day and hour on surface, parking and profile depth, sensor slices and area for acquisition and treatment (raw, average, ...). Transmission for each profile can also be programmed or not.

For example, in case a cycle is parametered for realizing 10 profiles, each of 9 first profiles can be transmitted or not at the end of each profile. Transmission will be forced by the float at the end of the last profile. In case no transmission were programmed during the nine first profiles, final transmission will send messages for the complete cycle.

### 4.7 Transmission

The data transmission process takes into account the limitations of the Iridium data collection system, including :

- the uncertainty of the float's antenna emerging in rough seas;
- radio propagation uncertainties due to weather conditions, and;
- the satellites' operational status.

ProvBioII creates transmission messages from the stored data.

Please refer to **section 7.** for a detailed description of the transmitted message formats.

## 5 PROVBIOLL PARAMETERS

ProvBioll can be controlled and parametered with 5 set of parameters :

- **Mission parameters**
- **Vector parameters**
- **Sensor parameters**
- **Technical parameters (not described in this manual. For specific request contact nke-instrumentation)**

ProvBioll 's configuration is determined by the values of its mission parameters defined below. Instructions on how to read and change the values of these parameters are provided in **sections 2.5.5**.

### 5.1 Mission Parameters

The following table summarizes all mission parameter names, ranges and default values.

Mission parameters are used to describe all profile in the cycle. For each profile, user has to set :Day and hour for surfacing, drift and Profile depth, and set if transmission is requested at end of the profile. All data acquired during profile with no transmission will be transmitted during 1<sup>st</sup> transmission.

	Abbr.	NAME	DEFAULT VALUE	UNIT	MIN VALUE	MAX VALUE
	PM0	Number of profiles per cycle	1	-	1	10
	PM1	Delay Before Mission	0	Minutes	0	1440
	PM2	Reference Day (day for 1 <sup>st</sup> surfacing during 1 <sup>st</sup> cycle after deployment)	1	Mission day	0	364
1 <sup>st</sup> P R O F I L E	PM3	Day for 1 <sup>st</sup> surfacing	1	Mission day	1	364
	PM4	Estimated hour for 1 <sup>st</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM5	Drift Depth	1000	dBars	100	2000
	PM6	Profile Depth	2000	dBars	100	2030
	PM7	Transmission for 1 <sup>st</sup> profile (0 = N, 1 = Y)	0		0	1
2 <sup>nd</sup> P R O F I L E	PM8	Day for 2 <sup>nd</sup> surfacing	1	Mission day	1	364
	PM9	Estimated hour for 2 <sup>nd</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM10	Drift Depth	1000	dBars	100	2000
	PM11	Profile Depth	2000	dBars	100	2030
	PM12	Transmission for 2 <sup>nd</sup> profile (0 = N, 1 = Y)	0		0	1
3 <sup>rd</sup> P R O F I L E	PM13	Day for 3 <sup>rd</sup> surfacing	1	Mission day	1	364
	PM14	Estimated hour for 3 <sup>rd</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM15	Drift Depth	1000	dBars	100	2000
	PM16	Profile Depth	2000	dBars	100	2030
	PM17	Transmission for 3 <sup>rd</sup> profile (0 = N, 1 = Y)	0		0	1
4 <sup>th</sup> P R O F I L E	PM18	Day for 4 <sup>th</sup> surfacing	1	Mission day	1	364
	PM19	Estimated hour for 4 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM20	Drift Depth	1000	dBars	100	2000
	PM21	Profile Depth	2000	dBars	100	2030

L E	PM22	Transmission for 4 <sup>th</sup> profile (0 = N, 1 = Y)	0		0	1
5 <sup>th</sup> P R O F I L E	PM23	Day for 5 <sup>th</sup> surfacing	1	Mission day	1	364
	PM24	Estimated hour for 5 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM55	Drift Depth	1000	dBars	100	2000
	PM26	Profile Depth	2000	dBars	100	2030
	PM27	Transmission for 5 <sup>th</sup> profile (0 = N, 1 = Y)	0		0	1
6 <sup>th</sup> P R O F I L E	PM28	Day for 6 <sup>th</sup> surfacing	1	Mission day	1	364
	PM29	Estimated hour for 6 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM30	Drift Depth	1000	dBars	100	2000
	PM31	Profile Depth	2000	dBars	100	2030
	PM32	Transmission for 6 <sup>th</sup> profile (0 = N, 1 = Y)	0		0	1
7 <sup>th</sup> P R O F I L E	PM33	Day for 7 <sup>th</sup> surfacing	1	Mission day	1	364
	PM34	Estimated hour for 7 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM35	Drift Depth	1000	dBars	100	2000
	PM36	Profile Depth	2000	dBars	100	2030
	PM37	Transmission for 7 <sup>th</sup> profile (0 = N, 1 = Y)	0		0	1
8 <sup>th</sup> P R O F I L E	PM38	Day for 8 <sup>th</sup> surfacing	1	Mission day	1	364
	PM39	Estimated hour for 8 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM40	Drift Depth	1000	dBars	100	2000
	PM41	Profile Depth	2000	dBars	100	2030
	PM42	Transmission for 8 <sup>th</sup> profile (0 = N, 1 = Y)	0		0	1
9 <sup>th</sup> P R O F I L E	PM43	Day for 9 <sup>th</sup> surfacing	1	Mission day	1	364
	PM44	Estimated hour for 9 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM45	Drift Depth	1000	dBars	100	2000
	PM46	Profile Depth	2000	dBars	100	2030
	PM47	Transmission for 9 <sup>th</sup> profile (0 = N, 1 = Y)	0		0	1
10 <sup>th</sup> P R O F I L E	PM48	Day for 10 <sup>th</sup> surfacing	1	Mission day	1	364
	PM49	Estimated hour for 10 <sup>th</sup> surfacing <sup>(1)</sup>	4	Hour in the day	0	23
	PM50	Drift Depth	1000	dBars	100	2000
	PM51	Profile Depth	2000	dBars	100	2030
	PM52	Transmission for 10 <sup>th</sup> profile (0 = N, 1 = Y)	1		0	1

**Table 1 - Summary of ProvBioII user-programmable Mission Parameters**

### 5.1.1 Mission Parameters details (PM)

#### **PM(0) Number of Different Profiles per Cycle**

This is the number of profiles of descent, submerged drift, ascent and transmission that ProvBioII will perform during one cycle. The mission ends and ProvBioII enters Life Expiry mode when this number of cycles has been completed.

The capacity of ProvBioII 's batteries is sufficient for at least 180 cycles (1 profile). If you wish to recover ProvBioII at the end of the mission, you must set the number of cycles at less than 180 to ensure there is sufficient battery capacity remaining to allow ProvBioII to return to the sea surface and enter Life Expiry.

Under favourable conditions, the battery capacity may exceed 180 cycles (possible more than 300 cycles depending on sensor equipment and sampling strategy). If you do not plan to recover the ProvBioII float, you may choose to set the number of cycles to 180 to ensure that ProvBioII completes the maximum number of cycles possible.

#### **PM(1) Delay Before Mission (minutes)**

To prevent ProvBioII from trying to sink while still on launch boat's, the float waits for this time before commanding the buoyancy engine to start the descent. After disconnection of the PC, followed by removal of the magnet, ProvBioII will wait for this delay before beginning the descent. The delay is measured after the first start of the pump which confirms the removal of the magnet (see [section 2.4.1](#)) and before the start of the descent.

#### **PM(2) Reference Day (day number)**

Allows you to configure a group of floats so that they all conduct their profiles at the same time. The parameter defines a particular day on which the first profile is to be made. When the float's internal clock's day number equals the reference day, it will conduct its first profile. The float's internal clock day number is set to zero when the mission starts. When setting the reference day, it is recommended to allow enough time between the deployment and reach of profiling depth. Using a reference day of at least 2 will ensure the first profile is complete.

PM3 to PM 7 for 1<sup>st</sup> profile

#### **PM(3) Day for 1<sup>st</sup> surfacing**

Relative day for 1<sup>st</sup> profile (float arrives on surface).

#### **PM(4) Estimated Hour on Surface (hours)**

Estimated time float must reach surface (associate to PM3 (or PM2 during first cycle after deployment) day).

#### **PM(5) Drift Depth (dbar)**

The depth at which ProvBioII drifts after completion of a descent while awaiting the time scheduled for the beginning of the next ascent.

#### **PM(6) Profile Depth (dbar)**

Depth at which profiling begins ascending profile. If ProvBioII is drifting at some shallower depth, it will first descend to the profile depth before starting the ascent profile.

#### **PM(7) Transmission**

Set if Iridium transmission is requested (0 = no, 1 = yes). Transmission will be forced by the float for last profile of the cycle.

#### **PM8 to PM12 for 2<sup>nd</sup> profile**

Identical PM3 to PM7 respectively for 2<sup>nd</sup> profile

#### **PM13 to PM17 for 3<sup>rd</sup> profile**

Identical PM3 to PM7 respectively for 3<sup>rd</sup> profile

#### **PM18 to PM22 for 4th profile**

Identical PM3 to PM7 respectively for 4th profile

**PM23 to PM27** for 5th profile

Identical PM3 to PM7 respectively for 5th profile

**PM28 to PM32** for 6<sup>th</sup> profile

Identical PM3 to PM7 respectively for 6<sup>th</sup> profile

**PM33 to PM37** for 7<sup>th</sup> profile

Identical PM3 to PM7 respectively for 7<sup>th</sup> profile

**PM38 to PM42** for 8<sup>th</sup> profile

Identical PM3 to PM7 respectively for 8<sup>th</sup> profile

**PM43 to PM47** for 9<sup>th</sup> profile

Identical PM3 to PM7 respectively for 9<sup>th</sup> profile

**PM48 to PM52** for 10th profile

Identical PM3 to PM7 respectively for 10<sup>th</sup> profile

### 5.2 Vector parameters (PV)

This set of parameters is used for programming in advance date for changing “Cycle period”.

5 different “cycle period” can be programmed in advance. These parameters must be used with great precautions, because mission parameters have also to be changed, because all surfacing days could be false with new cycle period.

NB : Use of pre-programmed cycle period is recommended only for mono-cycle profile, because in that case, day and hour on surface (mission parameters) have to adjusted for all profiles if more than one profile is set. Nke recommend not to use more than 1 pre-programmed cycle period for cycles with multi-profiles.

Abbr.	NAME	DEFAULT VALUE	UNIT	MIN VALUE	MAX VALUE
PV0	Number of different cycle duration	1		1	5
PV1	Iridium End-Of-Life Period	60	Minutes	10	7200
PV2	Iridium 2 <sup>nd</sup> session waiting time (“0” means no 2 <sup>nd</sup> session)	10	Minutes	0	360
PV3	Cycle Period1	24	Hours	24	4320
PV4	End Day for “Cycle Period” 1	31	Day	31	31
PV5	End Month for “Cycle Period” 1	12	Month	12	12
PV6	End Year for “Cycle Period” 1	99	Year	99	99
PV7	Cycle Period2	24	Hours	24	4320
PV8	End Day for “Cycle Period 2”	31	Day	31	31
PV9	End Month for “Cycle Period” 2	12	Month	12	12
PV10	End Year for “Cycle Period” 2	99	Year	99	99
PV11	Cycle Period3	24	Hours	24	4320
PV12	End Day for “Cycle Period 3	31	Day	31	31
PV13	End Month for “Cycle Period” 3	12	Month	12	12
PV14	Année de fin pour durée 3	99	Year	99	99
PV15	Cycle Period4	24	Hours	24	4320
PV16	End Day for “Cycle Period 4	31	Day	31	31
PV17	End Month for “Cycle Period” 4	12	Month	12	12
PV18	End Year for “Cycle Period” 4	99	Year	99	99
PV19	Cycle Period5	24	Hours	24	4320
PV20	End Day for “Cycle Period 5	31	Day	31	31
PV21	End Month for “Cycle Period” 5	12	Month	12	12
PV22	End Year for “Cycle Period” 5	99	Year	99	99

### **5.2.1 Vector Parameters details**

#### **PV(0) Number of different cycles Duration**

This parameter enables to anticipate cycle period modification. In case you want float realizes for example 5-days cycles up to a specific date, then 7 days-cycles, you can specify, 2 different duration. Float cycle period will be 5 days (PV3 = 5) up to date specify by PV4, 5 & 6. Once this date is reached, float will entered in 2<sup>nd</sup> period, considering PV7 as the new cycle period. Up the date specified with PV8, 9 & 10. Using several Cycle period is not recommended for multi-profiles cycles, because, changing Cycle period request also to modify Mission parameters for each profile.

#### **PV(1) Iridium End of life period (minutes)**

Transmission period (in minutes) once float is in “end of life mode” (all programmed cycles have been reached. Float send Technical message with refreshed GPS point.

#### **PV(2) Iridium Inter-cycles wait period (min)**

If this parameter is not null, a second iridium session (assigned to the next cycle number) will occur PV2 minutes after the last transmission session of tghe current cycle. This enables to check if a change on mission or technical parameter has been correctly treated by the float and if new parameters are effective for next cycle.

#### **PV(3) Cycle duration for period 1**

Indicate cycle duration for all the cycles that were programmed (i.e. until the date defined by PV4, PV5 and PV6

#### **PV(4) End of “period 1” day**

#### **PV(5) End of “period 1” month**

#### **PV(6) End of “period 1” year**

Once PV 4, 5 and 6 are reached, float will change cycle period to PV7 (Cycle duration for period 2) if at least 2 period are set (see PV 0), or float will enter in End-Of life mode if only one period was set

**Using more than 1 cycle period is not recommended in case of cycle with muti-profiles, because a cycle period change request also to modify hour and day for profile surfacing (PM parameters) and these parameters cannot be changed in advance (only with iridium telecommand), meaning risk of bad programmation increase highly.**



### 5.3 Sensor parameters (PC)

Each sensor has 2 sets of parameters :

**Standard parameters** and **Specific parameters**

**Standard parameters** deal with sampling period in each of the 5 zones in all phase (descent, drift, ascent, ....), slice thickness, threshold, treatment type and Power Supply Mode.

**Specific parameters** are used for setting different parameters linked exclusively to one sensor (Warm-Up time, calibration coefficients, ...).

**Standard parameters** structures are identical for all sensors. **Specific parameters** structures are different from one sensor to another.

#### 5.3.1 How to read and modify Sensor Parameter

To read sensor parameter, send the command :

**?PC x** with x Sensor number, according to the following table

Float will answer with all sensor parameter (standard and specific)

To modify Sensor parameter, send the command :

**!PC w x y z**, where **w** means Sensor number, **x** to indicate if this is standard (=0) or specific (=1) parameter, **Y** means parameter number, and **Z** value for parameter

Prior to sensor parameter modification, user have to unlock access, with command :

**!KC 1234**

Float will answer

Set measure !KC

LOCK UNLOCK Measure: READ/WRITE ACCESS

Same command is used for lock again parameters access

See [section 6](#) for details about User commands syntax and explanations

Sensor	Sensor number
CTD	0
Optode	1
FLBB	4

### 5.3.2 Standard parameter information

**Sampling Period** : Deal with period for each sensor acquisition of raw data (5 parameters per profile : 1 in any phase of float : descent to parking depth, drift at parking depth, descent to profile depth, drift at profile depth, ascent profile). If all sampling period (in each of the 5 zone) are set to “zero”, sensor is considered as “not mounted on Float”, meaning it is not tested during auto-test.

**NB** : A sensor not mounted (i.e. with all sampling period set to zero) at float deployment **MUST NOT BE ACTIVATED** then by Iridium telecommand during float’s mission. If user wants one sensor physically mounted on float and not active at the beginning of mission, he should set all “power acquisition mode” to zero. By this way, sensor will not be acquired until telecommand reception. If all sampling period are set to zero before deployment, memory organization is created without considering this sensor, so activate sensor during mission with telecommand will cause a failure in data memorization. That’s why, for specific mission with sensor not active at beginning, user have to set sampling period different from zero (so sensor will be tested during auto-test and memory organization will take in account), and uses “power acquisition mode” to activate or deactivate sampling.

**NB 2** : CTD must be active in all phase where other sensor are active. All measurements need to be referenced to a pressure before transmission. So, CTD must be active in any zone or phase if other sensor are active.

**Power Acquisition Mode** : You can choose, no acquisition (=0), pulsed mode (=2) or Continuous (=3).

Pulsed Mode means Sensor is Powered On for acquisition, then Supply is OFF until next sample (depending on requested sampling period). This mode enable to save energy. Using pulsed mode need precautions regarding sampling period.

Sampling period must be > (“Sensor Power Warm-up Time” + “Power OFF time between Power ON retry” + 2 seconds). If sampling period is too short regarding sensor specific parameters, mode will be forced in continuous mode. Specific parameters details are given in section 5.3.3

Continuous mode means sensor is continuously powered ON during ascent or descent profile.

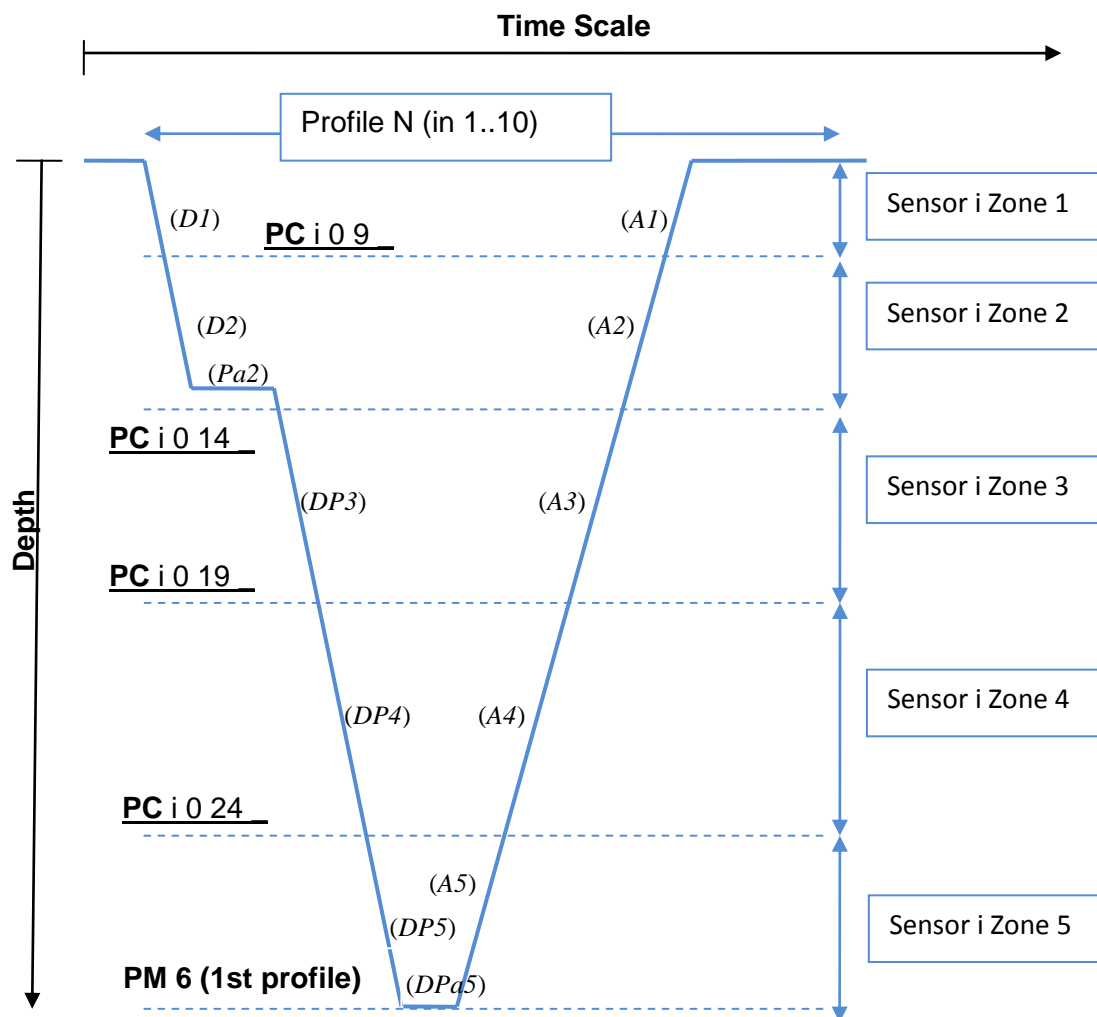
No acquisition means, sensor won’t be acquired

**Treatment Type** : Float acquires samples for each sensors, then these samples (called Raw data) are computed in accordance with zone (zone 1 for surface zone to zone 5 for the deepest zone) and slice thickness. Treatment consist in averaging (=3) (decimation then averaging) or in Averaging + additional information (Standard deviation and Median, in that case =7). If Standard deviation and Median are set, additional packets will be transmitted (Cf 7.2.4 describing packets formats).

**Slices thickness** : Used for raw data computation. In one slice, all raw data are computed to generate one treated data that will be transmitted in Iridium message.

**Threshold between zone** : Used to determine pressure target for slice thickness modification.

**Synchronization zone** : Not used.

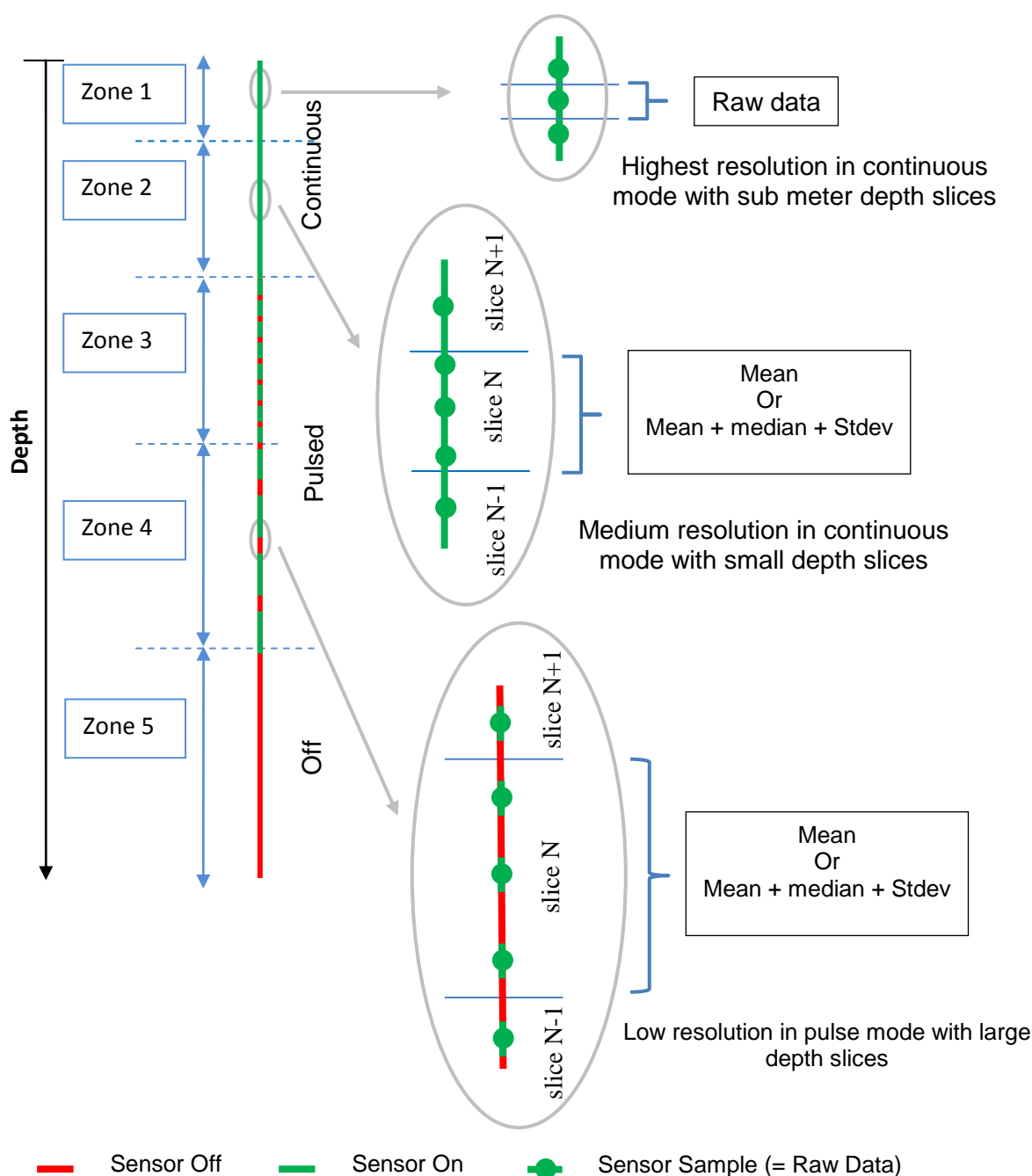


**Figure 3 - Sensor zone description**

For each sensor, profile is divided in 5 zone (separated with 4 thresholds between 5 zones) as described on figure 3.

Within each zone, could be defined :

- Acquisition mode (Off, Pulsed or Continuous)
- Data processing (raw, mean or mean + median + standard deviation) for transmission
- slice thickness (depth resolution) within which data will be processed.
- Sampling rate during float descent (D), Parking Drift (Pa), descent to starting profile depth (DP), deep parking (DPa) and ascent to surface (A).



**Figure 4 – Power Supply Mode description**

Sensor powering and data acquisition options along a profile. The ProvBioII float allows balancing power consumption and data resolution by controlling the sensor power supply, the sampling rate and the thickness of slices within which data will be processed. These parameters could be defined independently for each sensor for five depth intervals (Zones).

### 5.3.3 Specific parameter information

All specific parameters have been set in factory. Modification on specific parameters can cause trouble in sensor acquisition. Before specific modifications, contact **nke instrumentation**.

The 4 first specific parameters are identical for all sensor. Then following parameters are completely specific to each sensor.

- 1- **Sensor Power Warm-up Time** : This parameter indicates timing before sensor deliver 1<sup>st</sup> sample after sensor is powered ON.
- 2- **Power OFF time between Power ON retry** : this parameter indicates timing for sensor power to remain OFF before sensor is powered ON again, in order sensor power supply applies a good reset to sensor.
- 3- **1st «valid sample» rank** : This parameter indicates which sample can be considered as valid. Count begins from “0”, meaning first sample (raw data) coming from sensor is considered as valid.
- 4- **Number of raw data per slice in ECO mode** : not implemented for the moment.

In the specific parameters of a given sensor we usually can find :

**Min value** : Indicate for each measure, minimal value that will be acquired. Rejected if inferior

**Max value** : Indicate for each measure, maximal value that will be acquired. Rejected if superior

### 5.3.4 CTD parameters (Sensor “0”)

#### 5.3.4.1 CTD Standard parameters

STANDARD SENSOR PARAMETERS (TYPE 0) – SENSOR 0 (CTD)					
Abbr.	NAME	DEFAULT VALUE	UNIT	MIN VALUE	MAX VALUE
PC 0 0 0	Sampling period in descent to parking depth	0	sec	0	3600
PC 0 0 1	Sampling period in Parking Drift	60	min	0	3600
PC 0 0 2	Sampling period in Descent To Profile Depth	0	sec	0	3600
PC 0 0 3	Sampling period in Profile Depth Drift	0	min	0	3600
PC 0 0 4	Sampling period in Ascent Profile	10	sec	0	3600
PC 0 0 5	Power Acquisition Mode in zone 1 (0 : none, 2 : pulsed, 3 : continuous)	3		0	3
PC 0 0 6	Treatment Type in zone 1 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1		0	7
PC 0 0 7	Synchronization zone 1 (0 : None, 1 : CTD pressure) (NOT USED)	0		0	0
PC 0 0 8	Slices Thickness for zone 1	1	dBars	1	500
PC 0 0 9	Threshold zone 1/zone 2	10	dBars	10	2200
PC 0 0 10	Power Acquisition Mode in zone 2 (0 : none, 2 : pulsed, 3 : continuous)	3		0	3
PC 0 0 11	Treatment Type in zone 2 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1		0	7
PC 0 0 12	Synchronization zone 2 (0 : None, 1 : CTD pressure) (NOT USED)	0		0	0
PC 0 0 13	Slices Thickness for zone 2	5	dBars	1	500
PC 0 0 14	Threshold zone 2 / zone 3	200	dBars	1	2200
PC 0 0 15	Power Acquisition Mode in zone 3 (0 : none, 2 : pulsed, 3 : continuous)	3		0	3

PC 0016	Treatment Type in zone 3 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1		0	7
PC 0017	Synchronization zone 3 (0 : None, 1 : CTD pressure) (NOT USED)	0		0	0
PC 0018	Slices Thickness for zone 3	10	dBars	1	500
PC 0019	Threshold zone 3 / zone 4	500	dBars	1	2200
PC 0020	Power Acquisition Mode in zone 4 (0 : none, 2 : pulsed, 3 : continuous)	3		0	3
PC 0021	Treatment Type in zone 4 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1		0	7
PC 0022	Synchronization zone 4 (0 : None, 1 : CTD pressure) (NOT USED)	0		0	0
PC 0023	Slices Thickness for zone 4	20	dBars	1	500
PC 0024	Threshold zone 4 / zone 5	1000	dBars	1	2200
PC 0025	Power Acquisition Mode in zone 5 (0 : none, 2 : pulsed, 3 : continuous)	3		3	3
PC 0026	Treatment Type in zone 5 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1			7
PC 0027	Synchronization zone 5 (0 : None, 1 : CTD pressure) (NOT USED)	0			0
PC 0028	Slices Thickness for zone 5	25	dBars	1	500

See [section 5.3.2](#) for standard parameters details.

### 5.3.4.2 CTD Specific parameters

SPECIFIC SENSOR PARAMETERS (TYPE 1) – SENSOR 0 (CTD)					
Abbr.	NAME	DEFAULT VALUE	UNIT	MIN VALUE	MAX VALUE
PC 0 1 0	Sensor Power Warm-up Time	4800	msec	0	65535
PC 0 1 1	Power OFF time between Power ON retry	5000	msec	0	65535
PC 0 1 2	1st «valid sample» rank	0		0	255
PC 0 1 3	<u>Cut-off Pressure</u>	5	dBars	0	65535
PC 0 1 4	Min Pressure	-5	dBars	Mini float	Maxi float
PC 0 1 5	Max Pressure	2500	dBars	Mini float	Maxi float
PC 0 1 6	Min temperature	-5	m°C	Mini float	Maxi float
PC 0 1 7	Max temperature	50	m°C	Mini float	Maxi float
PC 0 1 8	Min salinity	0	mPSU	Mini float	Maxi float
PC 0 1 9	Max salinity	50	mPSU	Mini float	Maxi float
PC 0 1 10	Min ascent speed	0.083	m/s	0.01	0.5
PC 0 1 11	Min descent speed	0.01	m/s	0.01	0.5

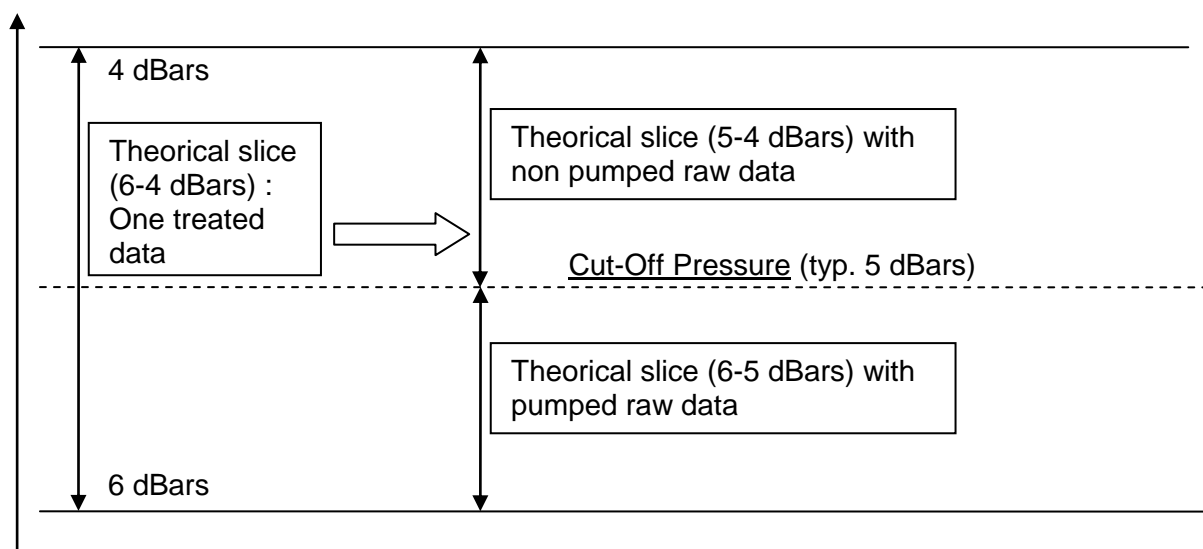
**Cut-Off Pressure** : indicate SBE 41 Cut-off Pressure. As float reach this pressure, in ascent profile, CTD pump is stopped, but CTD sample acquisition continues. In case this pressure is included inside a theoretical slice, an additional treatment is made by float, in order in 1 slice, samples acquired with and without pump are not averaged.

Example : 2 dBars slice on surface, with Cut-Off Pressure to 5 dBars. Cut-Off Pressure is included inside slice [4;6] dBars.

In that case, float will force a treatment with raw data included in range [6;5] dBars (with sample acquired as pump is active), and then realize another treatment with raw data included in range [5;4] dBars (raw data acquired as pump is not active).

By this way, a treated data cannot include raw data acquired with and without pumping.

See [section 5.3.3](#) for specific parameters details.



### 5.3.5 Optode Parameters (Sensor “1”)

#### 5.3.5.1 Optode Standard parameters

STANDARD SENSOR PARAMETERS (TYPE 0) – SENSOR 1 (OPTODE)					
Abbr.	NAME	DEFAULT VALUE	UNIT	MIN VALUE	MAX VALUE
PC 1 0 0	Sampling period in descent to parking depth	0	sec	0	3600
PC 1 0 1	Sampling period in Parking Drift	60	min	0	3600
PC 1 0 2	Sampling period in Descent To Profile Depth	0	sec	0	3600
PC 1 0 3	Sampling period in Profile Depth Drift	0	min	0	3600
PC 1 0 4	Sampling period in Ascent Profile	10	sec	0	3600
PC 1 0 5	Power Acquisition Mode in zone 1 (0 : none, 2 : pulsed, 3 : continuous)	3		0	3
PC 1 0 6	Treatment Type in zone 1 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1		0	7
PC 1 0 7	Synchronization zone 1 (0 : None, 1 : CTD pressure) (NOT USED)	0		0	0
PC 1 0 8	Slices Thickness for zone 1	1	dBars	1	500
PC 1 0 9	Threshold zone 1/zone 2	10	dBars	10	2200
PC 1 0 10	Power Acquisition Mode in zone 2 (0 : none, 2 : pulsed, 3 : continuous)	3		0	3
PC 1 0 11	Treatment Type in zone 2 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1		0	7
PC 1 0 12	Synchronization zone 2 (0 : None, 1 : CTD pressure) (NOT USED)	0		0	0
PC 1 0 13	Slices Thickness for zone 2	5	dBars	1	500
PC 1 0 14	Threshold zone 2 / zone 3	200	dBars	1	2200
PC 1 0 15	Power Acquisition Mode in zone 3 (0 : none, 2 : pulsed, 3 : continuous)	3		0	3
PC 1 0 16	Treatment Type in zone 3 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1		0	7
PC 1 0 17	Synchronization zone 3 (0 : None, 1 : CTD pressure) (NOT USED)	0		0	0
PC 1 0 18	Slices Thickness for zone 3	10	dBars	1	500
PC 1 0 19	Threshold zone 3 / zone 4	500	dBars	1	2200
PC 1 0 20	Power Acquisition Mode in zone 4 (0 : none, 2 : pulsed, 3 : continuous)	3		0	3
PC 1 0 21	Treatment Type in zone 4 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1		0	7
PC 1 0 22	Synchronization zone 4 (0 : None, 1 : CTD pressure) (NOT USED)	0		0	0
PC 1 0 23	Slices Thickness for zone 4	20	dBars	1	500
PC 1 0 24	Threshold zone 4 / zone 5	1000	dBars	1	2200
PC 1 0 25	Power Acquisition Mode in zone 5 (0 : none, 2 : pulsed, 3 : continuous)	3		3	3
PC 1 0 26	Treatment Type in zone 5 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1			7
PC 1 0 27	Synchronization zone 5 (0 : None, 1 : CTD pressure) (NOT USED)	0			0
PC 1 0 28	Slices Thickness for zone 5	25	dBars	1	500

See [section 5.3.2](#) for standard parameters details.



### 5.3.5.2 Optode Specific parameters

SPECIFIC SENSOR PARAMETERS (TYPE 1) – SENSOR 1 (OPTODE)					
Abbr.	NAME	DEFAULT VALUE	UNIT	MIN VALUE	MAX VALUE
PC 1 1 0	Sensor Power Warm-up Time	1500	msec	0	65535
PC 1 1 1	Power OFF time between Power ON retry	10000	msec	0	65535
PC 1 1 2	1st «valid sample» rank	0		0	255
PC 1 1 3	Min C1 phase	Mini float	deg	Mini float	Maxi float
PC 1 1 4	Max C1 phase	Maxi float	deg	Mini float	Maxi float
PC 1 1 5	Min C2 phase	Mini float	deg	Mini float	Maxi float
PC 1 1 6	Max C2 phase	Maxi float	deg	Mini float	Maxi float
PC 1 1 7	Min T°	Mini float	m°C	Mini float	Maxi float
PC 1 1 8	Max T°	Maxi float	m°C	Mini float	Maxi float

See [section 5.3.3](#) for specific parameters details.

### 5.3.6 FLBB Parameters (Sensor “4”)

#### 5.3.6.1 FLBB Standard parameters

STANDARD SENSOR PARAMETERS (TYPE 0) – SENSOR 4 (FLBB)					
Abbr.	NAME	DEFAULT VALUE	UNIT	MIN VALUE	MAX VALUE
PC 4 0 0	Sampling period in descent to parking depth	0	sec	0	3600
PC 4 0 1	Sampling period in Parking Drift	60	min	0	3600
PC 4 0 2	Sampling period in Descent To Profile Depth	0	sec	0	3600
PC 4 0 3	Sampling period in Profile Depth Drift	0	min	0	3600
PC 4 0 4	Sampling period in Ascent Profile	10	sec	0	3600
PC 4 0 5	Power Acquisition Mode in zone 1 (0 : none, 2 : pulsed, 3 : continuous)	3		0	3
PC 4 0 6	Treatment Type in zone 1 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1		0	7
PC 4 0 7	Synchronization zone 1 (0 : None, 1 : CTD pressure) (NOT USED)	0		0	0
PC 4 0 8	Slices Thickness for zone 1	1	dBars	1	500
PC 4 0 9	Threshold zone 1/zone 2	10	dBars	10	2200
PC 4 0 10	Power Acquisition Mode in zone 2 (0 : none, 2 : pulsed, 3 : continuous)	3		0	3
PC 4 0 11	Treatment Type in zone 2 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1		0	7
PC 4 0 12	Synchronization zone 2 (0 : None, 1 : CTD pressure) (NOT USED)	0		0	0
PC 4 0 13	Slices Thickness for zone 2	5	dBars	1	500
PC 4 0 14	Threshold zone 2 / zone 3	200	dBars	1	2200
PC 4 0 15	Power Acquisition Mode in zone 3 (0 : none, 2 : pulsed, 3 : continuous)	3		0	3
PC 4 0 16	Treatment Type in zone 3 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1		0	7
PC 4 0 17	Synchronization zone 3 (0 : None, 1 : CTD pressure) (NOT USED)	0		0	0
PC 4 0 18	Slices Thickness for zone 3	10	dBars	1	500
PC 4 0 19	Threshold zone 3 / zone 4	500	dBars	1	2200
PC 4 0 20	Power Acquisition Mode in zone 4 (0 : none, 2 : pulsed, 3 : continuous)	3		0	3
PC 4 0 21	Treatment Type in zone 4 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1		0	7
PC 4 0 22	Synchronization zone 4 (0 : None, 1 : CTD pressure) (NOT USED)	0		0	0
PC 4 0 23	Slices Thickness for zone 4	20	dBars	1	500
PC 4 0 24	Threshold zone 4 / zone 5	1000	dBars	1	2200
PC 4 0 25	Power Acquisition Mode in zone 5 (0 : none, 2 : pulsed, 3 : continuous)	3		3	3
PC 4 0 26	Treatment Type in zone 5 (0 : raw, 1 : average, 7 : Average/Median/Standard Deviation)	1			7
PC 4 0 27	Synchronization zone 5 (0 : None, 1 : CTD pressure) (NOT USED)	0			0
PC 4 0 28	Slices Thickness for zone 5	25	dBars	1	500

See [section 5.3.2](#) for standard parameters details.

### 5.3.6.2 FLBB Specific parameters

SPECIFIC SENSOR PARAMETERS (TYPE 1) – SENSOR 4 (FLBB)					
Abbr.	NAME	DEFAULT VALUE	UNIT	MIN VALUE	MAX VALUE
PC 4 1 0	Sensor Power Warm-up Time	3600	msec	0	65535
PC 4 1 1	Power OFF time between Power ON retry	4000	msec	0	65535
PC 4 1 2	1st «valid sample» rank	0		0	255
PC 4 1 3	Min Chlorophyll	0		Mini float	Maxi float
PC 4 1 4	Max Chlorophyll	4130		Mini float	Maxi float
PC 4 1 5	Min Scattering	0		Mini float	Maxi float
PC 4 1 6	Max Scattering	4130		Mini float	Maxi float
PC 4 1 7	Sensor Serial number	0		Mini float	Maxi float
PC 4 1 8	ScaleFactor Chlorophyll	1		Mini float	Maxi float
PC 4 1 9	DarkCounts Chlorophyll	0		Mini float	Maxi float
PC 4 1 10	ScaleFactor Scattering	1		Mini float	Maxi float
PC 4 1 11	DarkCounts Scattering	0		Mini float	Maxi float

See [section 5.3.3](#) for specific parameters details.

## 6 USER COMMANDS

Command	Rôle
!C	Float complete auto-test (CPU + measure board).
!CH	Measure Board Auto-test (Sensor)
!SE	Initiate Iridium transmission session
!PM x y	Set value y for “mission parameter” x
?PM	Screen all mission parameters
?PM x	Screen mission parameter x
!PT x y *	Set value y for “technical parameter” x
?PT *	Screen all technical parameters
?PT x *	Screen technical parameter x
!PV x y	Set value y for “vector parameter” x
?PV	Screen all vector parameters
?PV x	Screen vector parameter x
!PC w x y z **	Set value z (sensor w) for parameter number y (x=0 for standard parameter, x=1 for specific parameter)
?PC x	Request sensor parameter for sensor x
?PC x y z	Request parameter z for sensor x (standard parameter if y=0, specific parameter if y=1)
!SH x	Activate (x=1) or de-activate (x=0) Vector Show mode (MUST BE OFF FOR DEPLOYMENT)
?SH	Request show mode state
!TI jj mm aa hh mn ss	Set date and time to dd/mm/yy hh H : mn M : ss S
?TI	Request date and time for both CPU and measure board
?DH	Read all hydraulic data (pump and electrovalve activations)
?DT ALL x	Read all Treated Data for sensor x
?DB	Read all Raw Data for sensor x
!E x	Activate electrovalve for x cs (ctrl-c to stop)
!P x	Activate pump for x cs (ctrl-c to stop)
?ME x ***	Sensor x acquisition. X to identify sensor to be acquired
?VB	Request internal vacuum and battery voltage (in decivolt and millibars)
!AR x ****	Arm float (x=1) or deactivate arm mode (x=0)****
?AR	Request arm state
!RP	Parameters are transfered from EEPROM memory to RAM memory
!PO	Request GPS position
?VL	Request software version

?NS	Request float's serial number
!KV x	Command to activate or deactivate read/Write access for technical parameters. X value is communicated to users upon request to nke
!KC x	Command to activate or deactivate read/Write access for Sensors parameters. X value is communicated to users upon request to nke
!RV *****	External bladder is filled-in with Oil up to full position (float must be in vertical position)
?RE	Read the 5 last reset date and time
!PB	Request Battery Voltage with hydraulic pump active

\* : protected command (need !KV 1234 to unlock)

\*\* : protected command (need !KC 1234 to unlock)

\*\*\* : **Sensor type** :

0 = CTD, 1 = Optode, 4 = FLNTU

\*\*\*\* : As Armed Mode command is sent to float, float performs auto-test, and fill in external bladder, by activate hydraulic pump. Floats can pump up to several minutes depending on external bladder initial state.

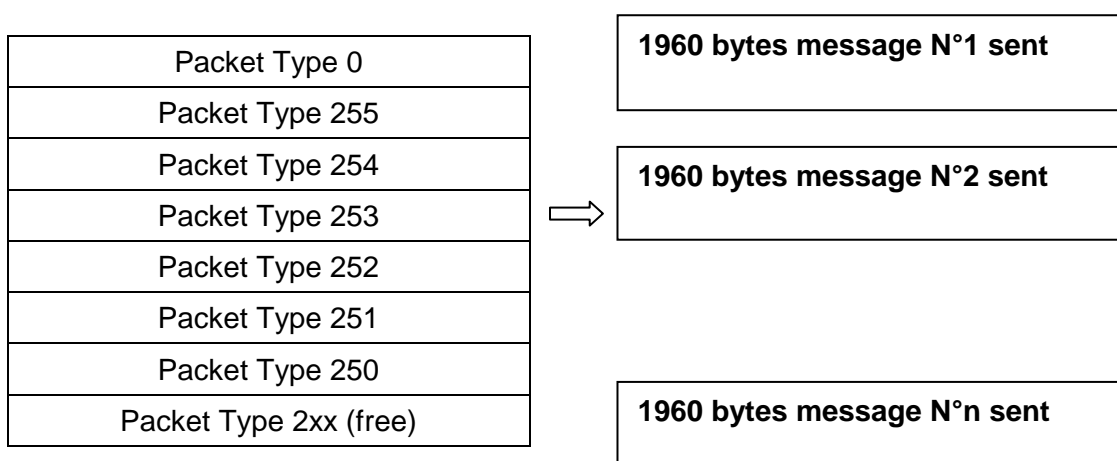
## 7 IRIDIUM FORMATS

### 7.1 Transmission strategy

Iridium format consists in transmitting file by rudics or SBD (size up to 1960 bytes in SBD mode and 1024 bytes in Rudics mode) coded in hexadecimal. Several messages can be necessary for a complete cycle transmission.

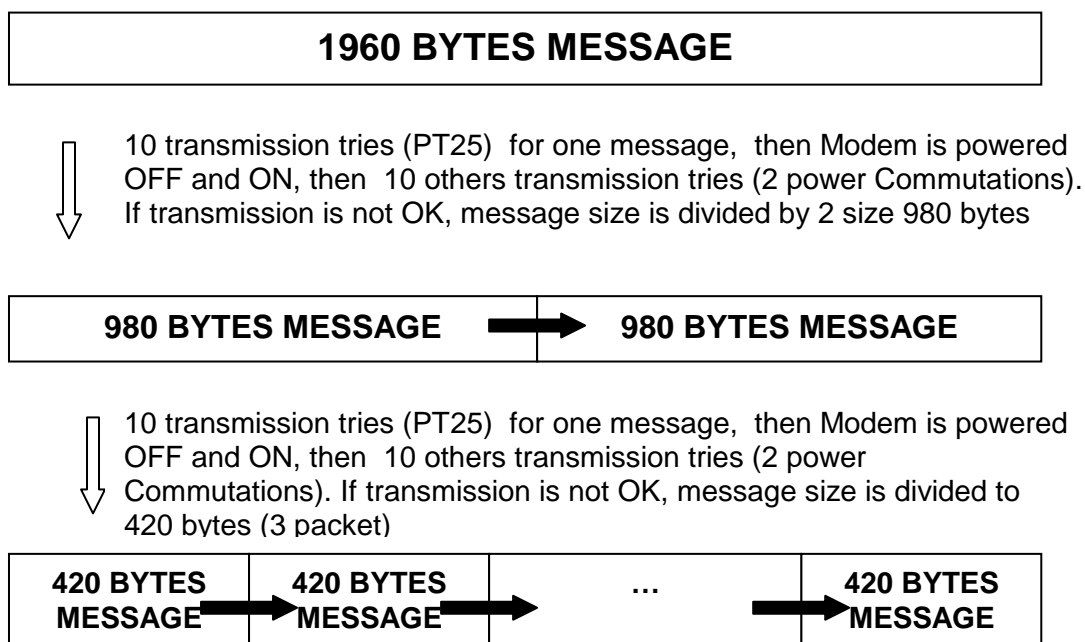
Messages are divided into elementary Packet (size 140 bytes). Maximum message contains 14 packets (SBD mode) or 5 packets (Rudics mode).

#### 1) SBD Packet creation then Message creation

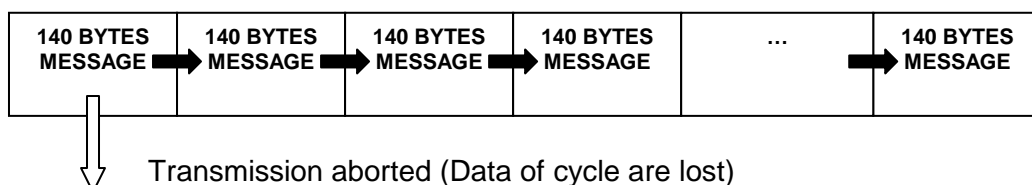


**Note :** Last message for a complete transmission session can be shorter than 1960 bytes.

#### 2) SBD Transmission Strategy



↓ 10 transmission tries (PT25) for one message, then Modem is powered OFF and ON, then 10 others transmission tries (2 power Commutations).  
If transmission is not OK, message size is reduced 140 bytes (1 packet)



**Note :** message size go back to superior size if transmission succeed.

## 7.2 Packet Types

Packet number	Packet Type (see “Sensors Data Type” section for description)
0	Sensor Data
...	Not used
250	Sensor Technical Data
251	PC Sensor Parameters
252	Vector Pressure Data
253	Vector Technical Data
254	PT Technical parameters
255	PV & PM Parameters

### 7.2.1 Sensor Data type

In Data messages (Packet type = 0), the field « Sensor data type » give the format of message, depending on transmitted sensor and treatment type (depending on PC parameter).

Sensor Data Type	Data Type
0	CTD (Average)
1	CTD (Standard deviation+ Median)
2	Not used
3	Oxygen (Average)
4	Oxygen (Standard deviation+ Median)
5	Not used
6	FLBB (Average)
7	FLBB (Standard deviation+ Median)

### 7.2.2 Phase description

All transmitted data are acquired during different phase in the cycle, here the description for each phase (included in all message)

Phase n°	Phase Name	Description
0	Pre-mission	Mission beginning (1st Iridium session)
1	Surface Waiting	Float wait's on surface between 2 Iridium session (if PV2 is not null)
2	Init new cycle	Float computes all timing for next cycle
3	Init new profile	Float computes all timing for next profile
4	Buoyancy reduction	Float descending phase at surface (up to PT specific threshold)
5	Descent to parking pressure	Float descend to Parking Pressure depth
6	Parking Drift	
7	Descent to profile pressure	
8	Drift at Profile Depth	
9	Ascent Profile	
10	Emergence	Float activate hydraulic pump to inflate external bladder to get enough buoyancy for Satellite transmission
11	Data treatment	Float computes all calculations on raw datas for transmission phase
12	Satellite transmission	Float transmit all sensor and technical packets
13	End of Profile	
14	End Of Life	Float has reached programmed number of cycle
15	Emergency ascent	Float ascent to surface in case of trouble
16	User Dialog Mode	Float is not yet on mission, waiting for User command by Bluetooth

### 7.2.3 Coding format

For coding all information inside message, different coding format will be used :

Coding Format	abreviation	Coding range
Unsigned Char	(UC)	[0;255]
Signed char	(CHAR)	[-128 ; 127]
Unsigned int	(UI)	[0 ; 65 535]
Signed int	(INT)	[-32 768 ; 32 767]
Unsigned Long Int	(U LONG INT)	[0 ; 4 294 967 295]
Long Int	(LONG INT)	[-2 147 483 648 ; 2 147 483 647]
Float	(F)	[3.4*10e-38 ; 3.4 * 10e38]



### 7.2.4 Packets Formats

#### 7.2.4.1 *Packet type 0 - CTD Data*

##### Resolution :

- Pressure : in cBar
- Temperature : in m°C with 2000m°C offset (except for standard deviation).
- Salinity : in mPSU
- Date and Hour : number of seconds since 1st january 2000

##### 7.2.4.1.1 Data Type : CTD (Average)

Data	Format (bytes)	Format (coding)
Packet Type: <b>0</b>	1	UC
Sensor Data Type : <b>0</b>	1	UC
Cycle number	2	UI
Profile Number	1	UC
Phase Number	1	UC
1 <sup>st</sup> Sample Date & Hour	4	U LONG INT
1 <sup>st</sup> Sample « Average Pressure »	2	INT
1 <sup>st</sup> Sample « Average Temperature »	2	UI
1 <sup>st</sup> Sample « Average Salinity »	2	UI
2 <sup>nd</sup> to 21 <sup>st</sup> Data blocks	(2+2+2)*20	
Complement (bits to zero)	4	
<b>Total</b>	<b>140</b>	

##### 7.2.4.1.2 Data Type : CTD (Standard deviation+ Median)

Data	Format (bytes)	Format (coding)
Packet Type: <b>0</b>	1	UC
Sensor Data Type : <b>1</b>	1	UC
Cycle number	2	UI
Profile Number	1	UC
Phase Number	1	UC
1 <sup>st</sup> Sample Date & Hour	4	U LONG INT
1 <sup>st</sup> Sample « Mean Pressure »	2	INT
1 <sup>st</sup> Sample « standard deviation temperature » (no offset)	1	UC
1 <sup>st</sup> Sample « standard deviation salinity »	1	UC
1 <sup>st</sup> Sample « Median Pressure »	2	INT
1 <sup>st</sup> Sample « Median temperature »	2	UI
1 <sup>st</sup> Sample « Median salinity »	2	UI
2 <sup>nd</sup> to 13th Data block	(2+1+1+2+2+2) * 12	
<b>Total</b>	<b>140</b>	

### 7.2.4.2 Packet type 0 – Oxygen Sensor data

#### Resolution :

- Pressure : in cBar
- C1/C2 Phase : in millidegrees
- Temperature : in m°C with a 2000m°C offset (except for standard deviation)
- Date and Hour : number of seconds since 1st january 2000

#### 7.2.4.2.1 Data Type : Oxygen (Average)

Data	Format (bytes)	Format (coding)
Packet Type: <b>0</b>	1	UC
Sensor Data type : <b>3</b>	1	UC
Cycle number	2	UI
Profile Number	1	UC
Phase Number	1	UC
1 <sup>st</sup> Sample Date & Hour	4	U LONG INT
1 <sup>st</sup> Sample « Mean Pressure »	2	INT
1 <sup>st</sup> Sample « C1 Phase »	4	LONG INT
1 <sup>st</sup> Sample « C2 Phase »	4	LONG INT
1 <sup>st</sup> Sample « temperature »	2	UI
2 <sup>nd</sup> to 10 <sup>th</sup> Data blocks	(2+4+4+2) * 9	
Complement	10	
<b>Total</b>	<b>140</b>	

#### 7.2.4.2.2 Data Type : Oxygen (Standard deviation+ Median)

Data	Format (bytes)	Format (coding)
Packet Type: <b>0</b>	1	UC
Sensor Data Type : <b>4</b>	1	UC
Cycle number	2	UI
Profile Number	1	UC
Phase Number	1	UC
1 <sup>st</sup> Sample Date & Hour	4	U LONG INT
1 <sup>st</sup> Sample « Mean Pressure »	2	INT
1 <sup>st</sup> Sample « standard deviation C1 Phase »	2	UI
1 <sup>st</sup> Sample « standard deviation C2 Phase »	2	UI
1 <sup>st</sup> Sample « standard deviation Temperature » (no offset)	1	UC
1 <sup>st</sup> Sample « Median C1 Phase »	4	LONG INT
1 <sup>st</sup> Sample « Median C2 Phase »	4	LONG INT
1 <sup>st</sup> Sample « Median Temperature »	2	UI
2 <sup>nd</sup> to 7 <sup>th</sup> Data blocks	(2+2+2+1+4+4+2) * 6	
Complement	11	
<b>Total</b>	<b>140</b>	

### 7.2.4.3 Packet type 0 – FLNTU Sensor Data

#### Resolution :

- Pressure : in cBar
- Chlorophyll : in « Count » \* 10
- Backscatter : in « Count » \* 10
- Date and Hour : number of seconds since 1st january 2000

#### 7.2.4.3.1 Data Type : FLBB (Average)

Data	Format (bytes)	Format (coding)
Packet Type: <b>0</b>	1	UC
Sensor Data type : <b>6</b>	1	UC
Cycle number	2	UI
Profile Number	1	UC
Phase Number	1	UC
1 <sup>st</sup> Sample Date & Hour	4	U LONG INT
1 <sup>st</sup> Sample « Mean Pressure »	2	INT
1 <sup>st</sup> Sample « Chlorophyll »	2	UI
1 <sup>st</sup> Sample « Backscatter »	2	UI
2 <sup>nd</sup> to 21 <sup>st</sup> data blocks (Pressure, Chlorophyll, Backscatter )	(2+2+2) * 20	
Complement	4	
<b>Total</b>	<b>140</b>	

#### 7.2.4.3.2 Data Type : FLNTU (Standard deviation+ Median)

Data	Format (bytes)	Format (coding)
Packet Type: <b>0</b>	1	UC
Sensor Data type : <b>7</b>	1	UC
Cycle number	2	UI
Profile Number	1	UC
Phase Number	1	UC
1 <sup>st</sup> Sample Date & Hour	4	U LONG INT
1 <sup>st</sup> Sample « Mean Pressure »	2	INT
1 <sup>st</sup> Sample « standard deviation Chlorophyll »	1	UC
1 <sup>st</sup> Sample « standard deviation Turbidity »	1	UC
1 <sup>st</sup> Sample « Median Chlorophyll »	2	UI
1 <sup>st</sup> Sample « Median Turbidity »	2	UI
2 <sup>nd</sup> to 16 <sup>th</sup> data blocks	(2+1+1+2+2) * 15	
Complement	2	
<b>Total</b>	<b>140</b>	

### 7.2.4.4 Packet Type 255 (Vector & Mission Parameters)

data	Format (bytes)	Format (coding)
Packet Type: <b>255</b>	1	UC
Packet Date/Hour (Day, month, Year, hour, minute, second)	6*1	6 * UC
Cycle Number	2	UI
Profile Number	1	UC
PV 0 - Number of different cycle durations (1 to 5)	1	UC
PV 1 - Iridium End Of Life Period(min)	2	UI
PV 2 - Iridium 2 <sup>nd</sup> session waiting time (min)	1	UC
PV 3 - Cycle Period1 (in hours)	2	UI
PV 4,5 &6 - End date for Duration1 (Day, Month, Year)	3 * 1	3 * UC
PV 7 - Cycle Period2 (in hours)	2	UI
PV 8, 9 & 10 - End date for Duration2 (Day, Month, Year)	3 * 1	3 * UC
PV 11 - Cycle Period3 (in hours)	2	UI
PV 12, 13 & 14 - End date for Duration3 (Day, Month, Year)	3 *1	3 * UC
PV 15 - Cycle Period4 (in hours)	2	UI
PV 16, 17 & 18 - End date for Duration4 (Day, Month, Year)	3 * 1	3 * UC
PV 19 - Cycle Period5 (in hours)	2	UI
PV 20, 21 & 22 - End date for Duration5 (Day, Month, Year)	3 * 1	3 * UC
PM 0 - Number of requested Profiles	1	UC
PM 1 - Delay before mission	2	UI
PM 2 - Reference Day	1	UC
PM 3 - Day for 1 <sup>st</sup> profile surfacing	1	UC
PM 4 - Estimated Hour on Surface	1	UC
PM 5 - 1 <sup>st</sup> Parking Depth (Bar)	2	UI
PM 6 - 1 <sup>st</sup> Profile Depth (Bar)	2	UI
PM 7 - Transmission	1	UC
2nd to 9th Day for surfacing + Hour + Pdrift + Pprofile + Transmission	(1+1+2+2+1) * 8	
PM 48 - 10 <sup>th</sup> profile Surfacing day	1	UC
PM 49 - 10 <sup>th</sup> Profile Surfacing hour	1	UC
PM 50 - 10 <sup>th</sup> Parking Depth (Bar)	2	UC
PM 51 - 10 <sup>th</sup> Profile Depth (Bar)	2	UC
PM 52 - 10 <sup>th</sup> Transmission	1	UC
Not Used (filled with zeros)	27	
<b>Total</b>	<b>140</b>	

### 7.2.4.5 Packet Type 254 (Technical parameters)

Data	Format (bytes)	Format (coding)
Packet Type: <b>254</b>	1	UC
Packet Date & Hour (Day, Month, Year, Hour, Minute, Second)	6*1	6 * UC
Cycle number	2	UI
Profile Number	1	UC
PT 0 - Max eV activation on Surface (in csec)	2	UC
PT 1 - Number of Valve activations target	2	UI
PT 2 - Pressure timing period during buoyancy reduction	2	UI
PT 3 - Pressure timing period during ascent (in min)	2	UI
PT 4 - Max volume eV during descent and repositioning	2	UI
PT 5 - Max duration pump during repositioning (in csec)	2	UI
PT 6 - Duration pump during ascent (in csec)	2	UI
PT 7 - Duration Pump during for surfacing (in csec)	2	UI
PT 8 - Pressure Delta for positioning (in dBars)	2	UI
PT 9 - Max pressure before emergency ascent (in dBars)	2	UI
PT 10 - 1 <sup>st</sup> threshold for buoyancy reduction (in dBars)	2	UI
PT 11 - 2 <sup>nd</sup> threshold for buoyancy reduction (in dBars)	2	UI
PT 12 - Repositioning threshold (in dBars)	2	UI
PT 13 - Grounding mode (0 = pressure switch, 1 stay grounded)	2	UI
PT 14 - Max volume before detecting grounding (in cm3)	2	UI
PT 15 - Grounding pressure (in dBars)	2	UI
PT 16 - Grounding switch pressure (in dBars)	2	UI
PT 17 - Pressure delta during drift (in dBars)	2	UI
PT 18 - Average descent speed (in mm/sec)	2	UI
PT 19 - Pressure increment (in dBars)	2	UI
PT 20 - Time-out modem Iridium (in min)	2	UI
PT 21 - Min ascent speed (in mm/sec)	2	UI
PT 22 - Average ascent speed (in mm/sec)	2	UI
PT23 - Wait period on surface after Emergency ascent (in min)	2	UI
PT24 - Volume to transfer after Buoyancy reduction (cm3)	2	UI
PT25 – Iridium Retries	2	UI
PT 26 – Coef 1	2	UI
PT 27 – Coef 2	2	UI
Not used (filled with zeros)	74	
<b>Total</b>	<b>140</b>	

### 7.2.4.6 Packet Type 253 (Vector Technical data)

Data	Format (bytes)	Format (coding)
<b>General Information</b>		
Packet Type : 253	1	UC
Float's time (Year, Month, Day, Hour, Minute, Second)	6	6 * UC
Float serial number	2	UI
Total number of profile	2	UI
Cycle number	2	UI
Profile Number	1	UC
Cycle Start Day (relative to mission start Day)	2	UI
Cycle Start Hour (resolution : 1 minute)	2	UI
Phase	1	UC
Sensor Board Dialog error (count)	2	UI
TimeOut FP (count)	2	UI
Internal Vacuum (modulo 5mbar, 5mbar resolution)	1	UC
Battery Voltage (Voltage dropout from 15V, resolution : 0.1V)	1	UC
RTC State	1	UC
<b>Buoyancy Reduction</b>		
Buoyancy Reduction Start Day (relative to mission start Day)	2	UI
Buoyancy Reduction Start Hour (resolution : 1 minute)	2	UI
Ev Timing opening (in minutes)	1	UC
number of valve actions at the surface	1	UC
<b>Descent to parking Depth</b>		
Parking Descent Start Day (relative to mission start)	2	UI
Parking Descent Start Hour (resolution : 1 minute)	2	UI
float stabilisation Day (relative to mission start)	2	UI
float stabilisation Hour (resolution : 1 minute)	2	UI
Parking Descent End Day (relative to mission start)	2	UI
Parking Descent End Hour (resolution : 1 minute)	2	UI
number of valve actions in descent	1	UC
number of pump actions in descent	1	UC
float stabilisation pressure (Resolution 1 Bar)	1	UC
Max pressure during descent to parking depth (Res : 1 Bar)	1	UC
<b>Parking Drift Phase</b>		
number of entrance in drift target range (descent)	1	UC
number of repositions	1	UC
minimum pressure in drift to parking depth (Res : 1 Bar)	1	UC
maximum pressure in drift to parking depth (Res : 1 Bar)	1	UC
number of valve actions in parking	1	UC
number of pump actions in parking	1	UC
<b>Descent To Profile Depth</b>		
Profile Descent Start Day (relative to mission start)	2	UI
Profile Descent Start Hour (resolution : 1 minute)	2	UI

Profile Descent End Day (relative to mission start)	2	UI
Profile Descent End Hour (resolution : 1 minute)	2	UI
number of valve actions in descent	1	UC
number of pump actions in descent	1	UC
max pressure in descent to Pprofile (Res : 1 Bar)	1	UC
<b>Profile Drift Phase</b>		
number of entrance in profile drift target range	1	UC
number of re-positioning in profile stand-by	1	UC
number of valve actions in drift at Profile depth	1	UC
number of pump actions in drift at Profile depth	1	UC
minimum pressure in drift to Pprofile (Res : 1 Bar)	1	UC
maximum pressure in drift to Pprofile(Res : 1 Bar)	1	UC
<b>Ascent Phase</b>		
Profile Ascent Start Day (relative to mission start)	2	UI
Profile Ascent Start Hour (resolution : 1 minute)	2	UI
Profile Ascent End Day (relative to mission start)	2	UI
Profile Ascent End Hour (resolution : 1 minute)	2	UI
number of pump actions in ascent	1	UC
<b>First Grounding Information</b>		
grounding detected (grounding = 1, No grounding = 0)	1	UC
Grounding pressure (Res : 1 Bar)	1	UC
First grounding day relative to mission start	2	UI
Hour at grounding (resolution : 1 minute)	2	UI
<b>Emergency Ascent Phase</b>		
Emergency ascent number	1	UC
1 <sup>st</sup> Emergency ascent time (resolution : 1 minute)	2	UI
1 <sup>st</sup> Emergency pressure (Res : Bar)	1	UC
number of pump actions in first emergency ascent	1	UC
1 <sup>st</sup> Emergency ascent relative day (to 1 <sup>st</sup> cycle day)	1	UC
<b>Iridium Remote Control</b>		
Remote control received	1	UC
Remote control rejected	1	UC
<b>GPS Data</b>		
GPS latitude in degrees	1	UC
GPS latitude in minutes	1	UC
GPS latitude in minutes fractions (1/10000)	2	UI
GPS latitude orientation (0= North, 1 = South)	1	UC
GPS longitude in degrees	1	UC
GPS longitude in minutes	1	UC
GPS longitude in minutes fractions (1/10000)	2	UI
GPS longitude orientation (0= East, 1 = West)	1	UC
GPS valid fix (1 = valid, 0 = not valid)	1	UC
Show mode Vector Board (0 : not active ; 1 active)	1	UC

Show mode Sensor Board (0 :not active ; 1 active)	1	UC
<b>Free (filled with zeros)</b>	<b>33</b>	
<b>TOTAL</b>	<b>140</b>	

- One technical packet per profile. In case of « multi profile » Cycle without transmission, several technical packet will be generated and transmitted.
- Float's Time is coded with 6 bytes : year (1byte) + month (1 byte) + day (1byte) hour (1 byte) + minute (1 byte) + second (1 byte).

### 7.2.4.7 Packet Type 252 (Pressure Packet)

Data	Format (bytes)	Format (coding)
Packet Type: <b>252</b>	1	UC
Cycle Number	2	UI
Phase & Profile Number (*) (Sample 1)	1	UC
Pump or ev (0 = eV, 1 = Pump) (Sample 1)	1	UC
Activation Pressure (Bars) (Sample 1)	1	UC
Relative Time (minutes / phase start) (Sample 1)	2	UI
Sample 2 to 27	(1+1+1+2) * 26	
Not used (filled with zeros)	2	
<b>Total</b>	<b>140</b>	

(\*) : Phase is coded on the 4first bits, Profile number with the last 4 bits

NB : Hydraulic actions in Buoyancy reduction are not included in this packet



### 7.2.4.8 Packet Type 251 (Sensor Parameters)

Only modified parameters since last Iridium session, are transmitted.

Data	Format (bytes)	Format (coding)
Packet Type: <b>251</b>	1	UC
1 <sup>st</sup> number of modified Sensor	1	UC
1 <sup>st</sup> Parameter Type (0 : Standard 1 : Specific)	1	UC
1 <sup>st</sup> Parameter Number	1	UC
1 <sup>st</sup> Old value	4	FLOAT
1 <sup>st</sup> New value	4	FLOAT
2nd to 12th modified sensor number + parameter type + parameter number + old value + New value	(1+1+1+4+4) * 11	
Not used (filled with zeros)	7	
<b>Total</b>	<b>140</b>	

### 7.2.4.9 Packet Type 250 (Sensor Technical Data)

Data	Format (bytes)	Format (coding)
General information		
Packet Type: 250	1	UC
<b>Data Type</b> : « X » (*)	1	UC
Cycle number	2	UI
Profile Number	1	UC
Type X transmitted Data		
Packet Number for « X » Type in descent	1	UC
Packet Number for « X » Type in drift	1	UC
Packet Number for « X » Type in ascent	1	UC
Type X acquired Data		
Descent, nb points zone 1	1	UC
Descent, nb points zone 2	1	UC
Descent, nb points zone 3	1	UC
Descent, nb points zone 4	1	UC
Descent, nb points zone 5	1	UC
Nb points in Drift	1	UC
Ascent, nb points zone 1	1	UC
Ascent, nb points zone 2	1	UC
Ascent, nb points zone 3	1	UC
Ascent, nb points zone 4	1	UC
Ascent, nb points zone 5	1	UC
X type Status Sensor (1 : normal, 0 if pb)	1	UC
Free Zone (specific to each sensor) (**)	50	
<b>TOTAL</b>	<b>70</b>	

Two “70 bytes packet” are included in “one 140 bytes packet” that is elementary packet

Float transmit “Sensor technical packet” for all sensor mounted on float. To set one sensor as mounted on float, user must set at minimum one sampling period (standard PC) as different from zero.

If all sampling period (standard PC) are equal to zero (for each sensor), it means that sensor is not mounted on float. In that case, sensor is not acquired during auto-test and during mission.

### (\*) Data Type

Sensor	Data Type
CTD	0
Optode	1
FLBB	4

### Free zone details by sensor (\*\*)

**N.B : Attention : Sensor information inside « free zone » are coded in « Little Endian » (\*\*\*)**

Free zone « CTD Data »	Format (bytes)	Format (coding)
Offset Pressure (Surface)	4	FLOAT (***)
Pressure « Subsurface »	4	FLOAT (***)
Temperature « Subsurface »	4	FLOAT (***)
Salinity « Subsurface »	4	FLOAT (***)
Free	34	
<b>TOTAL</b>	<b>50</b>	

Free zone « Optode Data »	Format (bytes)	Format (coding)
Free	50	
<b>TOTAL</b>	<b>50</b>	

Free zone « FLBBNTU Data »	Format (bytes)	Format (coding)
Sensor Serial number	2	UI (***)
Coefficient Scale factor Chlorophyll	4	FLOAT (***)
Coefficient Dark count Chlorophyll	2	UI (***)
Coefficient Scale factor Turbidity	4	FLOAT (***)
Coefficient Dark count Turbidity	2	UI (***)
Coefficient Scale factor Chlorophyll	4	FLOAT (***)
<b>TOTAL</b>	<b>50</b>	

### 7.3 Life Expiry Message

Life expiry messages are transmitted when the float is drifting on the surface and has completed transmission of all data from the last cycle of the Mission. Life Expiry mode continues until the recovery of the float, depletion of the battery, or telecommand sending for new mission beginning.

These transmissions - unlike other transmissions - occur at “PV1” minutes intervals (Vector parameter n° 1). The content of the life expiry message is identical to the technical message.

### 7.4 Packet transmitting sequence (Iridium session)

After each surfacing, the float, starts a transmission phase which begins with a GPS acquisition (set of RTC clock and acquisition of a GPS fix).

It then transmits all the data collected since its last surface transmission (i.e. corresponding to one or several profiles depending on profile transmission request set with PM parameters).

The transmitted messages are the following:

#### **Sensor measurement data:**

- sensor measurements (type 0); the number of messages depends on the amount of data to transmit (it is provided in the associated message type 250)

#### **Technical data:**

- one sensor technical message (type 250) per sensor
- one float technical message (type 253)
- pressure packets (type 252), the number of messages depends on the recorded hydraulic activations to transmit

#### **Configuration information:**

- 251, 254 and 255 message types to transmit parameters

During the second Iridium session (done when  $PV2 > 0$ ), only configuration information and the float technical message (only for the updated GPS fix) are transmitted.

### 7.5 Iridium commands

Each parameter (PM, PV, PC, PT and some PI) can be modified by sending an Iridium telecommand to the float.

PC modified parameter are immediately taken into account, other parameter modification will be considered for the next cycle of the float's mission. Modified values are sent back by the float through 255, 254 and 251 message types. Several parameter can be modified with one telecommand. Several telecommands can be send for one cycle.

### 7.5.1 Command Sending procedure (SBD MODE)

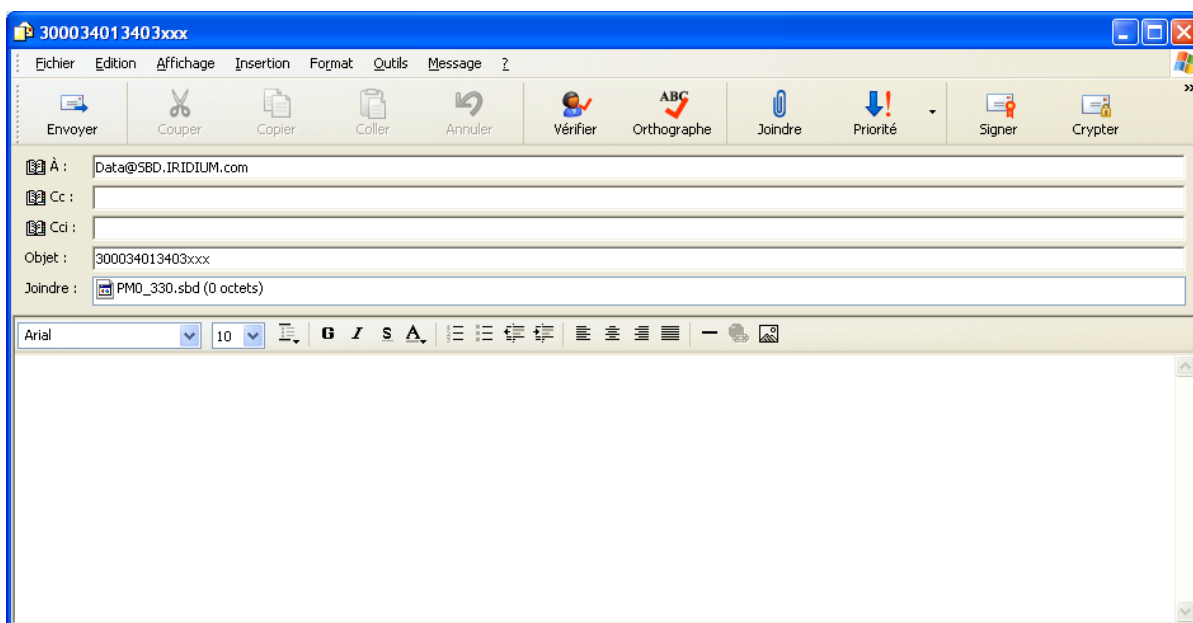
To send a telecommand to float in order to modify a mission parameter, User need to send an email with attached file containing text command

For example, to modify mission parameter 5 (drift pressure for 1<sup>st</sup> profile) from 1000 to 1050, user need :

- 1- to create an empty text file (with notepad or wordpad for example)
- 2- to type same command as command send to float with hyperterminal. In our example, user need to type in file : !PM 5 1050 followed by carriage return
- 3- save file as "PM5\_1050.txt"
- 4- close file
- 5- change file extension from ".txt" to ".sbd"

Once file is created, User must send email to Iridium system, with attached file.

- 6- Create an empty mail
- 7- In message subject, user must indicate float IMEI number (number only no other characters)  
**Be careful to indicate the right IMEI number in order not to send telecommand to another Iridium receiver or float)**
- 8- Email address is : Data@SBD.IRIDIUM.com
- 9- Attached file name "PM5\_1050.sbd"



Example of mail send to iridium system

- 10- Send mail

11- In a delay of a few minutes, user can check that iridium system send confirmation that message is queued (email coming from [sbdservice@sbd.iridium.com](mailto:sbdservice@sbd.iridium.com) with subject : “SBD Mobile Terminated Message Queued for Unit : xxxxxxxxxxxxxxxx (here xx replace IMEI number)

Mail from iridium will indicate :

“

*The following mobile-terminated message was queued for delivery:*

*IMEI: 300034013403xxx*

*Time: Thu Apr 29 12:00:13 2010*

*Attachment Filename: PM5\_1050.sbd*

*Attachment Size: 10*

*The MTMSN is 2, and the message is number 1 in the queue.*

“

At this step, message is queued and ready to be treated by float at next float surfacing.

Several command can be included in file. In that case do not forget to type carriage return after last command

**Important : Telecommand file size must be less than 260 bytes**

## **8 SPECIFICATIONS**

- Storage
  - Temperature range..... -20°C to +50°C
  - Storage time before expiry .....up to 1 year
- Operational
  - Temperature range..... 0°C to +40°C
  - Pressure at drift depth ..... 40 bar to 200 bar
  - Depth maintenance accuracy .....  $\pm 3$  bar typical (adjustable)
  - Survival at sea .....up to 4 years
  - Maximum number of cycles.....up to 255 cycles
- Mechanical
  - Length
    - with antenna .....#220 cm
  - Diameter
    - casing .....17 cm
    - damping disk ..... 35 cm
  - Weight.....46kg
  - Material..... anodized aluminum casing
- Sensors
  - Salinity
    - range..... 10 to 42 PSU initial
    - accuracy .....  $\pm 0.005$  PSU
    - resolution..... 0.001 PSU
  - Temperature
    - range... -3°C to +32°C initial
    - accuracy ..... $\pm 0.002^{\circ}\text{C}$
    - resolution.....0.001°C
  - Pressure
    - range... 0 bar to 2500 dbar initial
    - accuracy .....  $\pm 2.4$  dbar\*
    - solution.....0.1 dbar
    - Offset adjusted when surfacing
  - Oxygen
    - range... 0 bar to 500  $\mu\text{M/l}$  initial
    - accuracy .....  $\pm 8 \mu\text{M/l}$  (if  $< 160 \mu\text{M/l}$ ) or 5% (if  $> 160 \mu\text{M/l}$ )
    - resolution..... $< 1 \mu\text{M/l}$

(\*) offset has to be adjusted at each surfacing

## 9 PROVBIOII OPERATING PRINCIPLE

Movement of the float through its profile is accomplished by a pump and valve system. The pump transfers oil from the inner reservoir to the outer bladder. Oil moves back to the reservoir when the valve is opened- -driven by the difference between the float's internal and external pressures.

The float's speed of ascent oscillates. This oscillation is due to the way in which the float's controller regulates its speed. The controller, using depth measurements from the float's pressure sensor, calculates the change in depth over a set period of time. With this information, the controller determines the float's speed.

When ascending, if the calculated speed is lower than desired, the pump is activated for about 10 seconds, pumping oil into the outer bladder. This produces an increase in buoyancy, which increases the speed of ascent.

As the float rises to shallower depths, its buoyancy decreases, causing the ascent speed to also decrease. When the calculated speed is too low, the pump is activated again.

This cycle repeats until the float reaches the surface.

The same regulating method is used to control the float's descent speed, by opening the valve and allowing oil to flow from the external bladder to the internal reservoir.

### **Why does ProvBioII 's speed decrease as it ascends?**

The buoyancy of a float is determined principally by its mass and its volume, but another factor, hull compressibility, also plays an important role. As ProvBioII ascends, the decrease in water density reduces the float's buoyancy. At the same time, the decrease in water pressure causes ProvBioII 's hull to expand, which increases the float's buoyancy. The two effects tend to counteract each other.

Because ProvBioII 's compressibility is actually less than that of sea water, the decrease in buoyancy due to decreasing water density is greater than the increase in buoyancy due to hull expansion. This causes ProvBioII 's speed of ascent to decrease as it rises in the water column.

Conversely, as the float descends, the increasing water density increases the buoyancy more than the decreasing buoyancy from hull compressure. This causes ProvBioII 's speed of descent to slow as it goes deeper.

To reduce the probability of contact with ships, ProvBioII 's target speed during the initial stage of descent is high at shallow depths. This minimizes the time during which the float is at risk of damage.

To slow the float's descent, its controller is programmed with a series of depths at which the descent speed is halved until it reaches the target depth.

### 10 LITHIUM BATTERY

All batteries, both lithium batteries and batteries with other chemical elements, contain large quantities of stored energy. This is, of course, what makes them useful, but it also makes them potentially hazardous.

If correctly handled, neither alkaline nor lithium batteries present any risk to humans or the environment. Improper handling of these batteries presents potential risks to humans, but does not present an environmental risk.

The energy stored in a battery cell is stored in chemical form. Most batteries contain corrosive chemicals. These chemicals can be released if the cells are mishandled. Mishandling includes:

- short-circuiting the cells;
- (re)charging the cells;
- puncturing the cell enclosure with a sharp object;
- exposing the cell to high temperatures.

**WARNING: BOTH ALKALINE AND LITHIUM BATTERIES MAY EXPLODE, PYROLIZE OR VENT IF MIS-HANDLED. DO NOT DISASSEMBLE, PUNCTURE, CRUSH, SHORT-CIRCUIT, (RE)CHARGE OR INCINERATE THE CELLS. DO NOT EXPOSE CELLS TO HIGH TEMPERATURES.**

The lithium thionyl chloride cells used in ProvBioll floats incorporate sealed steel containers, warning labels and venting systems to guard against accidental release of their contents.

**WARNING: IF A BATTERY SPILLS ITS CONTENTS DUE TO MISHANDLING, THE RELEASED CHEMICALS AND THEIR REACTION PRODUCTS INCLUDE CAUSTIC AND ACIDIC MATERIALS, SUCH AS HYDROCHLORIC ACID (HCL) IN THE CASE OF LITHIUM THIONYL CHLORIDE BATTERIES, AND POTASSIUM HYDROXIDE (KOH) IN THE CASE OF ALKALINE BATTERIES. THESE CHEMICALS CAN CAUSE EYE AND NOSE IRRITATION AND BURNS TO EXPOSED FLESH.**

The hazard presented by these chemicals is comparable to that presented by common domestic cleaning materials like bleach, muriatic acid or oven cleaner.

Inevitably, the battery contents will eventually be released into the environment, regardless of whether the cells are deliberately dismantled or simply disintegrate due to the forces of nature. Because of their highly reactive nature, battery materials disintegrate rapidly when released into the environment. They pose no long-term environmental threat. There are no heavy metals or chronic toxins in ProvBioll 's lithium cells. Indeed, a recommended safe disposal method for thionyl chloride lithium cells is to crush them and dilute them in sufficient quantities of water.

Discharged batteries pose a greatly reduced threat, as the process of discharging them consumes the corrosive chemicals contained in them.

In summary, ProvBioll 's lithium battery poses no significant or long-term environmental threats. Any threats that they do present, are short-term threats to the safety of persons mishandling the cells. These safety threats are similar to those of other common household-use materials. These threats are reduced when the cells are discharged - and exist only if the cells are mishandled in extreme ways. These threats are the same as those presented by the alkaline cells widely used by consumers.



## 11 GLOSSARY

### **CPU**

Central Processing Unit. In the context of ProvBioll, this term denotes the board that ensures the running and control of the system.

### **COM1, COM2.**

Serial communication ports.

### **dBar.**

1/10 bar = 1 decibar Unit of pressure used for ProvBioll. It roughly corresponds to a depth of 1m.

### **IFREMER**

Institut Français pour la Recherche et l'Exploitation de la MER (French Institute for the Research and the Exploitation of the Sea).

### **Mission**

The portion of ProvBioll's life that consists of a number of repeating profiles of descent, submerged drift, ascent and data transmission.

### **PC**

Personal Computer; IBM-PC compatible.

### **ProvBioll**

Name given to the drifting profiler developed by **nke** and IFREMER.

### **RS232**

Widely recognized standard for the implementation of a serial data communication link.

### **VT52, VT100**

Video Terminal, type 52 or 100

Computer terminals developed by Digital Equipment Corporation (DEC). They are considered standard in the field.

*Fabriqu  par / Manufactured by*



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